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Preparatory Release Capacity: A Simulation-Based Decision Support System for Pre-Arrival Bail Planning Under Uncertainty

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Abstract: Monetary-bail decisions create a difficult planning problem because individuals may need to prepare for release before a court establishes whether bail will be imposed or the amount required. This study develops and evaluates a decision support system (DSS) for comparing pre-arrival preparation strategies under uncertainty. The artifact introduces Preparatory Release Capacity (PRC), defined as the combined liquidity readiness, coordination readiness, and funding certainty assembled before surrender. PRC is operationalized as a 0 to 6 index independent of simulated outcomes. The DSS uses Monte Carlo simulation with common random numbers to compare seven strategies across four synthetic bail environments calibrated to published national benchmarks. A 20,000-draw analysis generated 560,000 strategy-scenario observations. In unconstrained analyses, prepaid preparation minimized modeled initial detention in all environments, saving 2.67 to 7.69 hours relative to no preparation. Under a $300 expected-cost constraint, recommendations shifted across environments, demonstrating context-sensitive decision support. PRC was strongly associated with lower modeled initial detention, lower funding-shortfall probability, and greater hours saved. Across 48 sensitivity conditions, the modeled-delay-minimizing recommendation remained stable, while premium rates altered cost-effectiveness and coordination delays altered the magnitude of detention reduction. The artifact contributes a transparent, reproducible framework for evaluating preparation under uncertain release conditions while explicitly separating judicial decisions from post-decision coordination and liquidity mechanisms. The artifact is calibrated to the United States pretrial justice system and should not be interpreted as representing bail practices in all jurisdictions.

Keywords: bail, decision support systems, design science research, Monte Carlo simulation, pretrial detention, Preparatory Release Capacity

INTRODUCTION

Pretrial release frequently depends on decisions and resources assembled under severe uncertainty. Before a voluntary surrender on an active warrant, an individual may not know whether monetary bail will be imposed, what amount will be set, what payment mechanism will be accepted, or how quickly a commercial surety provider or family member can act. This sequence creates a prospective decision problem rather than merely a post-arrest financing problem. The decision maker must choose among preparation strategies before the amount is known.

The practical importance of this problem is substantial. National data have long shown that financial conditions play a central role in felony pretrial release, with commercial surety bonds historically serving as a common release mechanism in large urban counties (Cohen & Kyckelhahn, 2010). The typical monetary burden can be large relative to defendants' resources. The median bail amount for felony defendants has been reported at approximately $10,000, an amount estimated to equal roughly eight months of income for the typical detained defendant (Rabuy & Kopf, 2016). Bail practices also vary sharply across counties and over time, and average bail amounts doubled in large U.S. counties between 1990 and 2009 even after attention to case composition (Hood & Schneider, 2019).

Contemporary scholarship treats bail as an institutional field in which formal release objectives interact with revenue generation, social control, family resources, and unequal access to liberty (Page & Scott-Hayward, 2022). Reform has therefore proceeded unevenly. Although many jurisdictions have attempted to reduce reliance on money bail, pretrial detention remains shaped by public-safety concerns, judicial discretion, and the financial burdens attached to release (Carroll, 2023). These patterns reinforce the need for a decision artifact that makes its institutional assumptions explicit rather than treating release as a uniform process.

The consequences of detention also extend beyond immediate confinement. Federal evidence indicates that pretrial release can materially affect sentencing outcomes, including the probability of receiving a below-guidelines sentence (Didwania, 2020). Quasi-experimental studies further associate detention with reduced formal employment and wages after case disposition (Grau et al., 2023), while qualitative evidence identifies job loss, transportation disruption, and perceived employment barriers as mechanisms linking even short jail stays to longer-term instability (Smith, 2022). In addition, research on bail decisions finds substantial disparate impact by race (Arnold et al., 2022), making affordability, transparency, and equity important evaluation criteria for any release-planning artifact.

The central premise of this study is that release depends not only on nominal access to money but also on whether liquidity, coordination, and funding certainty are assembled in advance. A family may possess resources but lack an established process. A bondsman may be identified but the premium may exceed available cash. Savings may be available but insufficient for the full cash requirement. These differences motivate Preparatory Release Capacity (PRC), a construct that captures the readiness of a strategy to activate release after a monetary-bail decision.

This study asks three questions. First, how can a transparent DSS compare pre-arrival bail-planning strategies under uncertainty? Second, how is PRC associated with funding shortfalls and detention time within the designed artifact? Third, how robust are recommendations to bail exposure, bond-premium rates, coordination delays, and budget constraints? The study answers these questions through a design-science artifact, a reproducible Monte Carlo evaluation, efficient-frontier analysis, and sensitivity testing.

Beyond the bail setting, the study addresses a broader management problem: how decision support should represent resource readiness when obligations are uncertain, time sensitive, and conditioned by institutional decisions outside the user's control. The artifact contributes to business information systems and service operations by distinguishing resource possession from activation readiness, combining financial and relational resources

in an affordability-constrained recommendation model, and showing how transparent analytics can compress delay in regulated service processes. These ideas are relevant to legal-service organizations, nonprofit support providers, commercial surety operations, and public agencies that coordinate resources across institutional boundaries.

This study is explicitly grounded in the contemporary United States pretrial justice system and the use of monetary bail. The artifact assumes legal environments in which financial conditions of release, commercial surety bonds, cash bail, and related pretrial release mechanisms are available. Jurisdictions that prohibit commercial surety bonding, rely primarily on nonfinancial release, use substantially different pretrial procedures, or employ alternative legal frameworks may require different assumptions and parameterizations. Accordingly, the purpose of the artifact is not to represent pretrial release practices globally but rather to provide a transparent decision-support framework calibrated to U.S. bail processes and institutional arrangements.

This artifact is a synthetic research tool. It does not provide legal advice, estimate the outcome of an actual case, or recommend that any person surrender, post bail, or purchase a commercial bond without jurisdiction-specific advice from qualified counsel.

LITERATURE REVIEW

Monetary Bail, Affordability, and Pretrial Detention

Money bail conditions release on the ability to provide cash, property, a deposit, or a commercial surety bond. In the Bureau of Justice Statistics series on felony defendants in large urban counties, nearly 60% of felony defendants were released before adjudication, and financial conditions became the dominant route to release (Cohen & Kyckelhahn, 2010). Yet the existence of a release option does not establish affordability. Rabuy and Kopf (2016) showed that detained defendants were extremely poor relative to the monetary amounts demanded for release. Consequently, nominal eligibility for release can coexist with continued detention.

Bail practices are also institutionally heterogeneous. Hood and Schneider (2019) documented substantial within-county and between-county variation in bail regimes and a broad movement away from nonfinancial release. Their findings caution against treating any single bail amount or release probability as universal. A decision artifact should therefore expose its assumptions, permit scenario variation, and avoid presenting synthetic estimates as predictions of an actual court decision.

Recent empirical work also questions whether monetary conditions achieve their stated behavioral objectives. A Philadelphia policy change that sharply reduced low cash bail produced no evidence that financial collateral deterred failure to appear or pretrial crime (Ouss & Stevenson, 2023). Similarly, bail amount was not associated with failure to appear or rearrest in a county-jail study that compared money bail with structured pretrial risk scores (Zottola & Desmarais, 2022). These findings do not establish that financial conditions are irrelevant in every setting, but they distinguish the effectiveness of bail as an incentive from the practical ability to activate release after bail has been imposed.

International comparison further cautions against assuming that U.S. bail processes generalize to other legal systems. Comparative analysis of England and Wales and the

Netherlands shows that remand decisions vary in procedure, legal framework, decision structure, and the information available to judicial decision makers (Dhami & van den Brink, 2022). Research on risk-based justice likewise shows that the effects of assessment practices depend on how those practices distribute resources and are embedded across detention and release processes (van Eijk, 2020). Accordingly, the present DSS is intentionally bounded to the U.S. monetary-bail context and models judicial states as external inputs rather than universal rules.

Equity and policy reviews reach a similarly cautious conclusion. The U.S. Commission on Civil Rights documented the growth and civil-rights implications of pretrial detention (U.S. Commission on Civil Rights, 2022), while a 2024 synthesis of the research literature concluded that detention can affect court appearance, public safety, case outcomes, sentencing, and collateral well-being through different short- and long-term pathways (Advancing Pretrial Policy & Research, 2024). Causal research also links pretrial detention to increased conviction, largely through guilty pleas, and to reduced formal-sector employment (Dobbie et al., 2018). These findings strengthen the rationale for measuring detention time while avoiding claims that the DSS determines whether monetary bail should be imposed.

The consequences of delayed release extend beyond the hours spent in custody. Reviews of the pretrial system identify employment loss, housing instability, disruption of family responsibilities, and altered case outcomes as potential consequences of detention (Stevenson & Mayson, 2017). Time to release is also unequally distributed. Kenney and Dolliver (2022), using survival analysis, found that women in a rural county jail took longer than men to post bail after controlling for bail amount, age, and race. Their findings reinforce the proposition that time to release reflects social and economic capacity, not merely the amount set.

Release Mechanisms and Coordination

A release mechanism provides a financial pathway, but it does not eliminate operational delay. After bail is established, the defendant or support network may need to locate funds, contact a commercial surety provider, execute agreements, provide collateral, transmit payment, and wait for administrative release processing. These tasks are distinct from booking and judicial bail setting. The separation is theoretically important because preparation cannot control the court's decision, but it may reduce the coordination interval after that decision.

The model evaluates seven alternatives: no preparation, family support, emergency savings, a pre-arranged bondsman, prepaid premium preparation, family support combined with a bondsman, and maximum preparation combining savings, family support, and a bondsman. These alternatives differ in both resources and process readiness. The artifact does not presume that commercial surety is socially optimal or superior on public-safety outcomes. Recent research comparing release mechanisms has questioned claims that commercial surety bonds outperform deposit or cash alternatives on rearrest and failure-to-appear outcomes (Stolzenberg & D'Alessio, 2026). The present artifact addresses a narrower question: conditional on a monetary-bail requirement, which preparation strategy minimizes modeled detention and funding shortfalls within stated constraints?

The distinction between release eligibility and release activation is central to the artifact. Evidence that cash bail may be weakly related to appearance or rearrest (Ouss & Stevenson, 2023; Zottola & Desmarais, 2022) does not eliminate the operational problem faced once a court has imposed a payable condition. The DSS therefore evaluates only the downstream readiness of funding and coordination pathways. Recent statewide evidence also shows that legal reforms can materially change the frequency of bail and remand across offense categories and regions (Rempel et al., 2026), underscoring the importance of jurisdiction-specific parameterization.

Continued Detention and Subsequent Release Pathways

The current artifact focuses on the period immediately following a monetary-bail decision and models release as a function of funding availability, coordination readiness, and release-processing delays. This design isolates the operational effects of pre-arrival preparation. However, inability to satisfy a monetary-bail requirement does not necessarily imply detention until final case disposition. Defendants who cannot immediately meet financial conditions may remain detained, obtain judicial reconsideration, or later enter an alternative release pathway.

One pathway is continued detention pending case resolution. When neither the defendant nor supporting parties can satisfy the imposed condition and no alternative mechanism is authorized, detention may continue until charges are dismissed, a plea agreement is reached, sentencing occurs, or the case proceeds to trial. Research associates extended pretrial detention with sentencing differences, reduced employment prospects, and increased conviction through guilty pleas (Didwania, 2020; Dobbie et al., 2018; Grau et al., 2023). These consequences help justify attention to the initial interval in which funding shortfalls and coordination delays may prevent release activation.

A second pathway involves judicial reconsideration. Depending on jurisdiction and charge, courts may review or reduce bail, substitute conditions, authorize unsecured or supervised release, or grant release on recognizance. Bail-reform research demonstrates that the availability and use of these mechanisms vary across legal systems, regions, offense categories, and reform periods (Carroll, 2023; Dhami & van den Brink, 2022; Rempel et al., 2026). Inability to satisfy bail at booking is therefore a substantial barrier to release, but not necessarily a permanent one. These pathways define an important boundary for the present DSS. The model estimates initial detention through activation of the specified monetary-bail pathway; it does not predict total pretrial confinement or ultimate release status. A funding shortfall triggers the modeled unprepared-coordination interval rather than indefinite detention. Future versions should add stochastic states for bail review, modified conditions, nonfinancial release, unsecured bonds, and case resolution. The current outputs should therefore be interpreted as preparation-attributable release delay within the designed artifact.

Design Science Research

Design science research develops and evaluates artifacts intended to improve human or organizational capabilities (Hevner et al., 2004). The method is appropriate when the research problem requires a purposeful system, method, model, or instantiation rather than

explanation alone. Peffers et al. (2007) organized design-science work into problem identification, solution objectives, design and development, demonstration, evaluation, and communication. The present study follows that sequence by defining the decision problem, specifying transparent design requirements, implementing a Python artifact, demonstrating it across calibrated scenarios, and evaluating it with verification tests, Monte Carlo experiments, budget constraints, efficient frontiers, and sensitivity analysis.

Evaluation is not a single end-stage test in design science research. The FEDS framework distinguishes formative from summative purposes and artificial from naturalistic settings, and it asks researchers to align evaluation goals, strategies, properties, and episodes (Venable et al., 2016). Recent work similarly emphasizes that evaluation methods should be chosen according to the artifact, the criteria being assessed, and the intended claims (Müller et al., 2024). The present study follows that logic by combining artificial evaluation through simulation with verification tests, sensitivity analysis, and decision-quality comparisons.

Validity is especially important when an artifact introduces a construct such as PRC. Design-science validity frameworks call for explicit attention to the validity of research processes and artifact-related knowledge claims (Larsen et al., 2020). Practitioner evaluation can complement technical assessment by testing applicability, novelty, completeness, internal coherence, flexibility, and usability (Moutinho et al., 2024). For that reason, the present correlations are treated as internal nomological evidence, whereas practitioner ratings and jurisdiction-specific field data are reserved for future external validation.

Preparatory Release Capacity

Preparatory Release Capacity is introduced as a provisional formative design index defined as the degree to which financial, relational, and procedural resources are assembled before surrender so that a monetary-bail obligation can be activated with minimal funding uncertainty and coordination delay. PRC contains three dimensions: liquidity readiness, coordination readiness, and funding certainty. Each dimension is scored from 0 to 2, producing a total score from 0 to 6.

Liquidity readiness represents accessible resources relative to the contemplated funding pathway. Coordination readiness represents the extent to which contacts, documentation, and a release pathway are arranged before the bail amount is known. Funding certainty represents confidence that the selected pathway can actually produce the required payment. The construct is intentionally evaluated from strategy attributes rather than simulated outcomes. This separation avoids defining high PRC as whatever happens to perform well, which would make subsequent associations circular.

The 0–2 anchors are design choices rather than empirically estimated scale points. A score of 0 indicates that the dimension is absent from the strategy specification, 1 indicates partial or contingent readiness, and 2 indicates that the strategy specification provides the strongest readiness represented in the artifact. Equal weighting is used for transparency, not because the dimensions have been shown to have equal empirical effects. Component profiles are therefore retained alongside the total, and equal totals should not be interpreted as equivalent configurations.

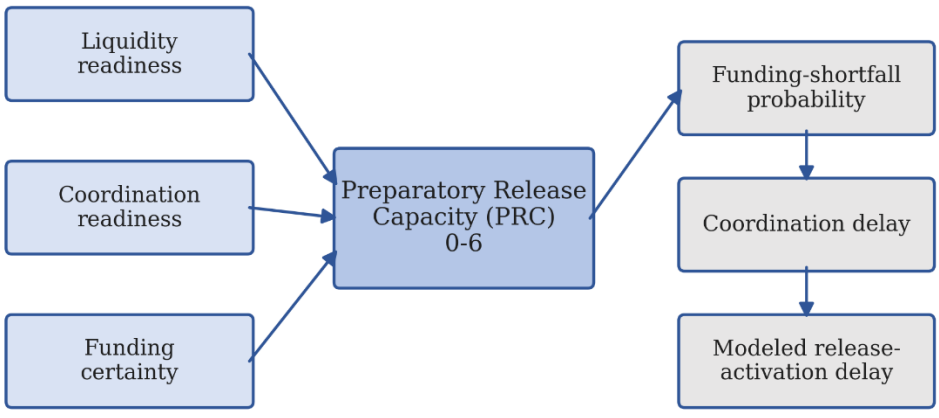
Table 1 presents the operationalization of the three PRC dimensions across the seven preparation strategies. Figure 1 depicts the proposed relationships among PRC, funding shortfalls, coordination delay, and modeled release-activation delay.

Table 1: PRC Operationalization by Strategy

Strategy	Liquidity	Coordination	Certainty	PRC
No preparation	0	0	0	0
Family ready	1	1	0	2
Emergency savings	2	0	2	4
Pre-arranged bondsman	1	2	1	4
Family plus bondsman	1	2	1	4
Maximum preparation	2	2	2	6
Prepaid premium	2	2	2	6

The model anticipates that PRC will reduce funding-shortfall probability and coordination delay, which in turn reduce modeled release-activation delay. It also anticipates that the practical value of PRC will increase when bail exposure and unprepared coordination delays are high.

- H1: Higher PRC is associated with lower funding-shortfall probability.
- H2: Higher PRC is associated with lower modeled initial detention time.
- H3: Higher PRC is associated with more detention hours saved relative to no preparation.
- H4: The value of PRC increases as bail exposure and coordination delay increase.



Bail exposure and unprepared coordination delay condition the practical value of PRC.

Figure 1: Conceptual Model of Preparatory Release Capacity

Note. PRC is modeled as a formative readiness construct. Bail exposure and unprepared coordination delay condition the practical value of preparation.

METHOD

Artifact Architecture

The Python artifact separates stages that the decision maker cannot control from stages potentially affected by preparation. The sequence is custody, booking, monetary-bail determination, conditional bail amount, funding-pathway evaluation, coordination delay, and release processing. Judicial states are external stochastic inputs. The artifact does not estimate guilt, dangerousness, flight risk, judicial discretion, or whether surrender is advisable.

Figure 2 summarizes the gate-based DSS architecture and distinguishes external judicial inputs from the downstream preparation mechanisms evaluated by the artifact.

The DSS includes scenario loading, strategy loading, input validation, common-random-number simulation, PRC scoring, summary statistics, budget-constrained recommendation, efficient-frontier analysis, sensitivity analysis, and SHA-256 output hashes. Thirteen automated tests verify parameter validation, row counts, reproducibility, bail medians, frontier construction, recommendation logic, sensitivity-case counts, PRC ranges, PRC endpoint scores, summary fields, and association output.

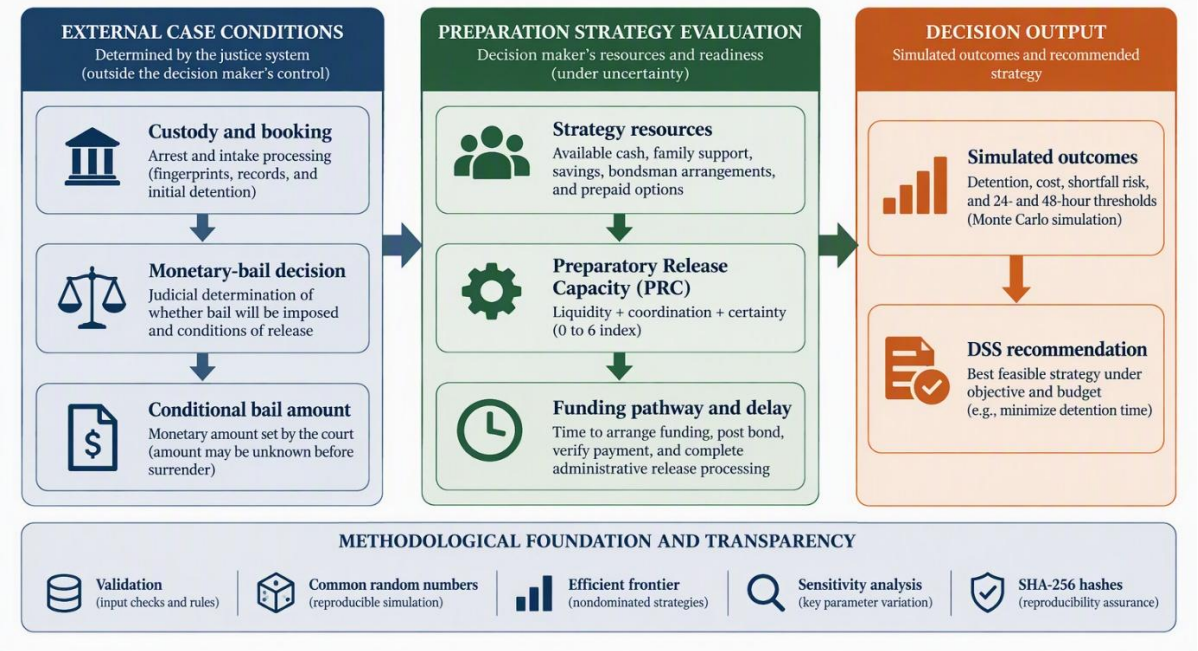


Figure 2: Gate-Based Decision Support System Architecture

Note. Judicial states are treated as external stochastic inputs. The DSS evaluates downstream funding pathways, delays, outcomes, and recommendations. Infographic generated with Microsoft Copilot and reviewed by the authors.

Scenarios and Calibration

Four synthetic bail environments were created with median bail amounts of $2,500, $10,000, $25,000, and $50,000. The $10,000 scenario corresponds to the widely cited national median for felony defendants, while the $25,000 scenario reflects higher violent-

felony medians reported in large-county data (Cohen & Kyckelhahn, 2010; Rabuy & Kopf, 2016). The $2,500 environment represents a lower-exposure case, and the $50,000 environment is a stress test rather than a claim about a national median. Bail amounts follow lognormal distributions because monetary amounts are nonnegative and right-skewed.

The principal timing calibration uses 2 to 6 hours for booking, 4 to 24 hours for unprepared coordination, 0.5 to 2 hours for a pre-arranged bondsman response, 0 to 1 hour for prepaid response, and 2 to 12 hours for release processing. Because direct peer-reviewed estimates of the funding-coordination interval are limited, the coordination ranges are treated as calibrated assumptions rather than population parameters. Sensitivity tests use 4 to 12, 4 to 24, and 12 to 48 hours.

The 0–1 hour prepaid-response interval is not an empirically established release-time distribution. It is a calibrated best-case readiness assumption representing the strongest preparation condition in the artifact, in which advance contact, preliminary documentation, and premium funding are already in place before the bail amount is known. The interval applies only to the modeled response needed to activate the prepared funding pathway after bail is set; it does not include booking, judicial bail determination, or subsequent jail release processing. Because direct peer-reviewed estimates of prepaid or pre-arranged bond activation time are unavailable, this parameter requires practitioner or timestamp validation. The 0–1 hour prepaid-response interval was held fixed in the reported 48-condition sensitivity grid. Accordingly, recommendation stability across those conditions establishes robustness to premium rates and unprepared coordination-delay assumptions, but not to alternative prepaid-activation-time assumptions.

Table 2 reports the scenario parameters used in the principal simulation experiment.

Table 2: Synthetic Scenario Parameters

Environment	Median Bail	Custody P	Monetary Bail P	Bail Sigma
Lower-end nonviolent	$2,500	.40	.50	.65
Typical felony	$10,000	.55	.60	.80
Serious felony	$25,000	.70	.70	.90
High-bail tail	$50,000	.75	.75	1.00

Table 3 summarizes the provenance and interpretation limits of the principal model parameters.

Table 3: Parameter Provenance and Interpretation Boundaries

Parameter	Base value / rule	Status	Sensitivity or boundary
Median bail	$2,500; $10,000; $25,000; $50,000	$10,000 and $25,000 are literature-calibrated; $2,500 is a lower-exposure case; $50,000 is a stress test	Jurisdiction-specific recalibration required

Custody probability	.40 to .75	Synthetic scenario input	Not a prediction of arrest or detention for an actual case
Monetary-bail probability	.50 to .75	Synthetic scenario input	Not a judicial prediction
Bail sigma	.65 to 1.00	Assumed right-skew parameter	Should be estimated from jurisdictional data
Booking time	2–6 hours	Calibrated assumption	External to preparation strategy
Unprepared coordination	4–24 hours	Calibrated assumption	Sensitivity ranges: 4–12, 4–24, and 12–48 hours
Pre-arranged response	0.5–2 hours	Calibrated assumption	Requires practitioner or timestamp validation
Prepaid response	0–1 hour	Calibrated best-case readiness assumption; not an empirical release-time estimate	Represents activation of a prepared funding pathway only; excludes booking, bail setting, and jail release processing; practitioner or timestamp validation required The response interval was held fixed in the reported sensitivity grid.
Release processing	2–12 hours	Calibrated assumption	External administrative delay
Premium rate	10% principal analysis	Scenario parameter	Sensitivity rates: 5%, 10%, 15%, and 20%
Budget constraint	$300 expected cost	Illustrative user-defined threshold	Not an empirical affordability standard

Simulation and Decision Rules

The main experiment used 20,000 draws for each of seven strategies in four environments, producing 560,000 strategy-scenario observations. Common random numbers ensured that each strategy faced the same simulated custody, monetary-bail, bail-amount, booking, coordination, and release-processing draws within an environment. This paired structure reduces simulation noise when comparing alternatives. The design therefore contains 80,000 independent environmental draws across four environments; the 560,000 strategy-scenario rows reuse those draws across seven alternatives and are not 560,000 independent cases.

The simulation design follows established guidance to state the aims, data-generating mechanisms, estimands, methods, and performance measures, while using reproducible random-number control and transparent reporting (Morris et al., 2019). Monte Carlo methods are also useful for exploring decision robustness when criteria or parameter weights are uncertain (Mazurek & Strzałka, 2022). In this artifact, common random numbers provide paired comparisons across strategies, and the sensitivity grid reveals whether recommendations depend on premium and delay assumptions rather than on incidental simulation noise.

For each draw, the model calculated funding requirements, available resources, shortfalls, modeled initial detention time, out-of-pocket cost, and whether detention exceeded 24 or 48 hours. Strategy summaries included mean, median, and 90th-percentile detention; expected out-of-pocket cost; shortfall probability; threshold probabilities; hours saved relative to no preparation; and incremental cost per hour saved. The unconstrained recommendation minimized mean modeled initial detention, then shortfall probability and

cost. A second, illustrative analysis minimized modeled initial detention subject to expected cost not exceeding $300. The $300 value is not an empirical affordability threshold; it demonstrates the artifact's user-defined budget function and should be varied for a specific user or jurisdiction. A strategy was classified as efficient if no alternative had both no higher cost and no higher modeled release-activation delay with at least one strict improvement.

Evaluation Design

Evaluation proceeded through four layers. First, automated tests verified implementation behavior. Second, the unconstrained and budget-constrained experiments assessed decision quality under different objectives. Third, efficient-frontier analysis evaluated cost and detention tradeoffs. Fourth, 48 sensitivity conditions crossed four bail environments, three coordination ranges, and four premium rates of 5%, 10%, 15%, and 20%. Pearson correlations summarized descriptive associations between the strategy-level PRC index and simulated outcomes. Because only seven strategies contribute to each correlation and the outcomes are generated by the artifact, these coefficients are evidence of internal nomological behavior rather than independent construct validation.

RESULTS

Unconstrained Recommendations

Prepaid preparation minimized modeled release-activation delay in all four environments. Mean detention ranged from 4.51 hours in the lower-exposure environment to 8.55 hours in the tail environment. Compared with no preparation, the prepaid strategy saved 2.67, 4.45, 6.67, and 7.69 hours as bail exposure increased. The simulated outcomes were consistent with H3 and directionally consistent with H4 under the specified data-generating assumptions.

Table 4 summarizes the unconstrained recommendations across the four environments.

Table 4: Unconstrained DSS Recommendations

Environment	Recommended	PRC	Modeled release-activation delay (hours)	Hours Saved
Lower-end nonviolent	Prepaid	6	4.51	2.67
Typical felony	Prepaid	6	6.22	4.45
Serious felony	Prepaid	6	7.96	6.67
High-bail tail	Prepaid	6	8.55	7.69

Budget-Constrained Recommendations

The $300 expected-cost constraint produced context-dependent recommendations. Prepaid remained feasible and optimal in the lower-exposure environment. In the typical felony environment, family support combined with a pre-arranged bondsman became optimal. A pre-arranged bondsman was selected in the serious-felony environment, and family plus

bondsman was selected in the tail environment. The changing recommendations demonstrate that the DSS does not mechanically select the maximum PRC score when affordability is constrained. Table 5 reports the budget-constrained recommendations and shows that affordability changes the preferred strategy.

Table 5: Recommendations Under a $300 Expected-Cost Constraint

Environment	Recommended	PRC	Mean Cost	Hours Saved
Lower-end nonviolent	Prepaid	6	$111.36	2.67
Typical felony	Family + bondsman	4	$290.39	3.61
Serious felony	Bondsman	4	$131.77	1.34
High-bail tail	Family + bondsman	4	$206.29	1.23

PRC Associations

PRC displayed strong associations in the hypothesized directions. Across the four principal environments, correlations between PRC and modeled release-activation delay ranged from -.93 to -.75. Correlations between PRC and funding-shortfall probability ranged from -.92 to -.79. Correlations between PRC and hours saved ranged from .75 to .93. Thus, the simulated artifact exhibited relationships consistent with H1, H2, and H3 under the specified scoring rules and data-generating assumptions; these associations do not constitute independent empirical validation.

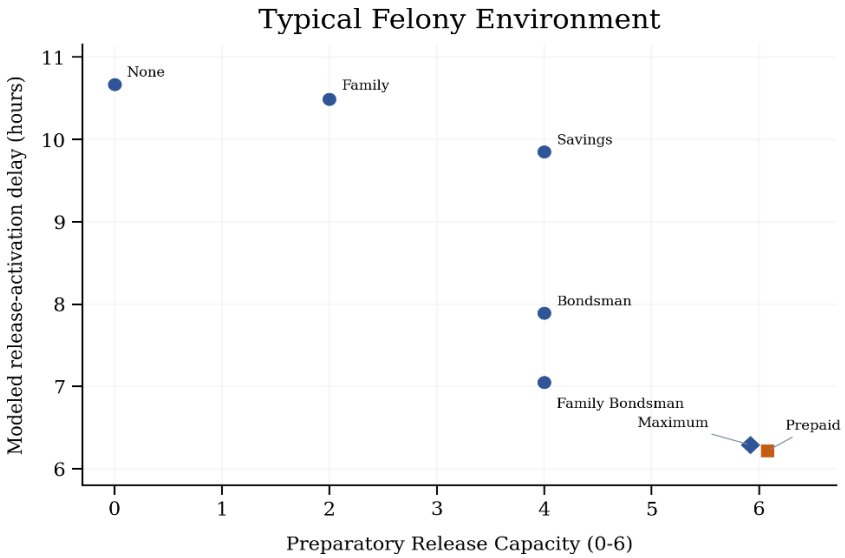


Figure 3: Preparatory Release Capacity and Modeled Release-Activation Delay

Note. Each point represents one preparation strategy in the typical felony environment. PRC is scored from strategy attributes and is independent of the simulated outcome. The vertical axis represents modeled release-activation delay, not total pretrial confinement.

Table 6 reports the strategy-level PRC associations. Figure 3 visualizes the inverse association between PRC and mean detention in the typical felony environment while also showing that strategies with equal PRC totals can produce different outcomes.

Table 6: Strategy-Level PRC Associations

Environment	PRC-Modeled Delay	PRC-Shortfall	PRC-Hours Saved
Lower-end nonviolent	-.933	-.920	.933
Typical felony	-.876	-.861	.876
Serious felony	-.826	-.839	.826
High-bail tail	-.755	-.785	.755

Efficient-Frontier Analysis

The efficient-frontier analysis identified strategies that were not dominated simultaneously on expected cost and modeled release-activation delay. Figure 4 displays the typical felony environment, where the frontier makes the cost–detention tradeoff visible and shows why a single static ranking is insufficient for constrained decisions.

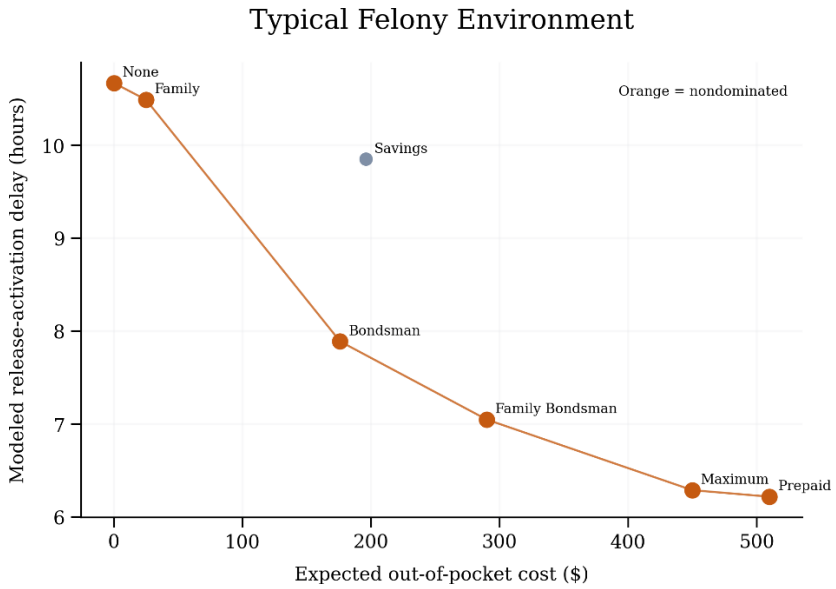


Figure 4: Cost-Release-Activation-Delay Efficient Frontier

Note. Orange points are nondominated strategies in the typical felony environment. A strategy is dominated when another alternative has no higher expected cost and no higher modeled release-activation delay, with at least one strict improvement. The vertical axis represents the initial release-activation interval defined by the artifact.

Sensitivity Analysis

The prepaid strategy remained the detention-minimizing recommendation in all 48 unconstrained sensitivity conditions. Premium-rate variation changed expected cost but did not change prepaid detention because the prepaid strategy was modeled as fully funded. Coordination delay changed the magnitude of benefit substantially. Under the 12-to-48-hour coordination condition, prepaid hours saved reached 5.89 in the lower-exposure environment, 9.59 in the typical felony environment, 14.59 in the serious-felony environment, and 16.92 in the tail environment. This model-generated pattern was consistent with H4 across the examined unprepared coordination-delay conditions.

Figure 5 shows that coordination delay changes the magnitude of detention reduction across all four bail environments, whereas the detention-minimizing recommendation remains stable.

Cost-effectiveness deteriorated as premium rates increased. For example, in the lower-exposure, short-delay condition, prepaid incremental cost per detention hour saved increased from approximately $54.55 at a 5% premium to $117.96 at a 20% premium. In the $50,000 tail environment with short delays, the corresponding value increased from approximately $582.98 to $2,296.98. Premiums therefore influenced efficiency more than modeled detention effectiveness.

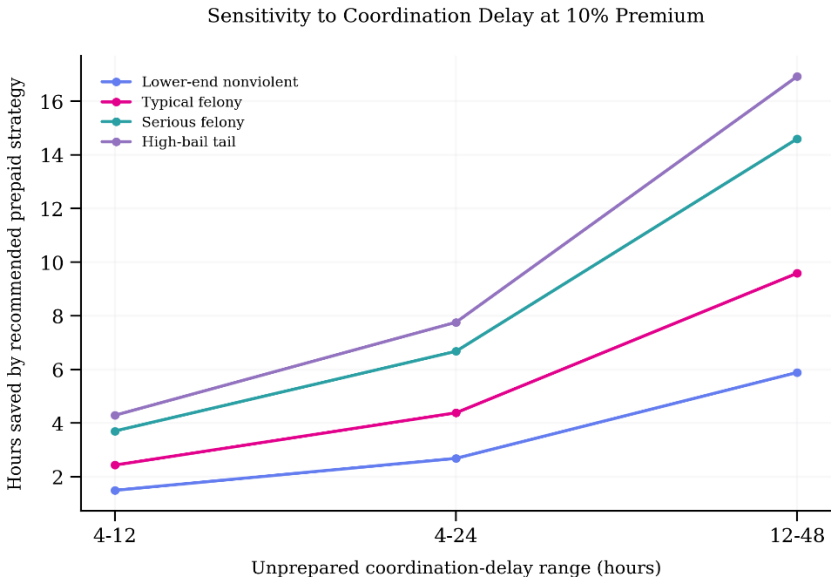


Figure 5: Sensitivity of Hours Saved to Coordination Delay

Note. Lines show hours saved by the recommended prepaid strategy at a 10% premium rate. Values are based on the 5,000-draw sensitivity experiment.

DISCUSSION

Theoretical Contributions

The primary theoretical contribution is PRC, which distinguishes possession of resources from readiness to activate release. Equal PRC totals do not always produce equal outcomes because the composition of capacity matters. In the typical felony environment, savings, bondsman, and family-plus-bondsman strategies can share a PRC total of 4 while producing different detention outcomes. Savings supplies liquidity and certainty but little coordination readiness. Bondsman strategies supply coordination but may remain vulnerable when premium requirements exceed available cash. This pattern suggests that PRC should be treated as a formative multidimensional construct rather than a reflective unidimensional scale.

As illustrated in Figure 3 and summarized in Table 6, higher PRC is associated with lower modeled release-activation delay, but the dispersion among equal-PRC strategies indicates that dimensional composition matters.

The results also identify coordination delay as a moderator. Preparation has limited absolute value when unprepared coordination is already fast, but it has much larger value when coordination could take 12 to 48 hours. This finding reframes pre-arrival planning as delay compression. The mechanism is not that preparation changes the judicial decision. Rather, preparation compresses the interval between the monetary-bail decision and activation of an accepted release mechanism.

Figure 5 makes this moderation pattern visible: the absolute value of preparation rises sharply as the unprepared coordination interval expands.

Design Contributions

The artifact demonstrates how a gate-based DSS can support decisions in a legally sensitive context without predicting judicial behavior. It treats custody, bail imposition, and bail amount as scenario inputs, then evaluates only downstream strategies. This design boundary is important because it preserves transparency about what the artifact can and cannot influence. The use of common random numbers, structured output files, validation rules, automated tests, efficient-frontier analysis, and cryptographic hashes also supports reproducibility.

The budget-constrained results illustrate why a DSS adds value beyond a static ranking. Without a budget constraint, prepaid preparation always minimizes detention. With a $300 limit, different environments yield different feasible optima. The contribution therefore lies not in declaring one universally best strategy but in making tradeoffs explicit under user-defined constraints.

The contrast between Tables 4 and 5 demonstrates this context sensitivity, while Figure 4 shows the underlying cost–detention tradeoff.

Practical and Policy Implications

Practically, the artifact suggests that advance coordination can be more consequential than savings alone. A person with modest resources and a verified operational pathway may outperform a person with larger but insufficient liquid savings. However, the model should not be deployed as individualized legal advice. State and county rules differ; some jurisdictions restrict commercial bail, accept different forms of payment, use nonfinancial release, or impose preventive detention. Attorneys and local court personnel must verify the permissible pathway.

Liquidity readiness depends not only on the nominal amount of available resources but also on whether those resources are immediately accessible and accepted by the relevant court, jail, payment processor, or commercial surety provider. For example, a prepaid debit card or other stored-value payment instrument loaded with funds before surrender may provide a lower-friction payment source than savings that require a check to clear, a transfer to settle, or third-party authorization. This potential speed advantage is conditional rather than universal because jurisdictions and commercial providers differ in the payment methods they accept, transaction limits, identity-verification requirements, and processing procedures. The DSS should therefore treat a loaded prepaid card as an example of immediately accessible liquidity only when the intended payment recipient has

verified that the instrument will be accepted. A prepaid debit card is treated here as a potential liquidity instrument and is conceptually distinct from the model's prepaid-premium strategy.

The artifact is most applicable to individuals who do not already possess established release pathways. A person with substantial prior experience navigating pretrial release may already have an ongoing relationship with a commercial surety provider, a previously verified indemnity or collateral arrangement, trusted cosigners, and established payment mechanisms. In those circumstances, parts of coordination readiness and funding certainty may already be present before the focal surrender event. The marginal benefit of new preparation may therefore be smaller for individuals with pre-existing release infrastructure than for individuals who must assemble a release pathway for the first time.

The results also expose a policy tension. High PRC can reduce modeled detention once money bail is imposed, but the cost of achieving high PRC rises sharply with bail amount and premium rate. In the tail environment, the prepaid option can minimize detention while producing very high expected costs. The DSS therefore illustrates the private burden created by reliance on financial release without endorsing that institutional arrangement.

LIMITATIONS AND FUTURE RESEARCH

First, all case outcomes are synthetic. The analysis evaluates the consequences of stated assumptions and does not estimate actual detention for a particular defendant or jurisdiction. Second, direct empirical estimates of coordination time are scarce. The timing ranges require validation against booking, bond-posting, and release timestamps or structured practitioner elicitation. Third, PRC scores were designed by the researcher. Strong internal associations are expected because the same strategy attributes influence both PRC and simulation mechanics. External construct validation is therefore essential.

Another limitation concerns prior release-system experience. The artifact implicitly assumes that release preparation activities begin before the focal surrender event and that coordination pathways must be assembled specifically for that event. However, some defendants may already possess established relationships with commercial surety providers, previously verified collateral arrangements, trusted cosigners, standing financial resources, or other release-support infrastructure developed through prior interactions with the justice system. In such circumstances, portions of liquidity readiness, coordination readiness, and funding certainty may already exist before a new bail determination occurs. The incremental value of additional preparation may therefore be lower for defendants who maintain pre-existing release pathways than for those building a release pathway for the first time. Future research should model prior release-system experience as a moderating variable affecting Preparatory Release Capacity and expected release-activation delays.

A next study should ask commercial bail agents, criminal-defense attorneys, public defenders, and court administrators to rate the seven strategies on liquidity readiness, coordination readiness, and funding certainty. Interrater agreement, convergent validity, and expert-DSS rank correspondence could then be assessed. A second extension should estimate PRC weights rather than assuming equal dimension ranges. A third should model jurisdiction-specific rules and alternative mechanisms such as deposit bonds, full cash bonds, unsecured bonds, and release on recognizance. A fourth should conduct value-of-

information analysis to identify which uncertain parameter most warrants empirical measurement.

The recommendation objective also warrants refinement. Minimizing expected detention is only one possible objective. Future versions should support multi-attribute utility functions that incorporate detention, expected cost, worst-case cost, collateral exposure, refundability, and risk tolerance. Equity analysis should examine whether preparation strategies are differentially feasible across income groups. None of these extensions should be interpreted as legitimizing unaffordable bail; rather, they can clarify how institutional requirements translate into private burdens.

CONCLUSION

This study developed a transparent DSS for pre-arrival bail planning under uncertainty and introduced Preparatory Release Capacity as a readiness construct composed of liquidity, coordination, and funding certainty. In the synthetic evaluation, higher PRC was consistently associated with fewer funding shortfalls, lower modeled release-activation delay, and more hours saved. The unconstrained recommendation was stable across 48 sensitivity conditions, but affordability constraints produced context-dependent alternatives. Coordination delay governed the magnitude of detention reduction, whereas premium rates governed cost-effectiveness. The artifact contributes a reproducible method for separating judicial decisions from downstream release activation and for comparing strategies without claiming to predict case outcomes. External practitioner validation and jurisdiction-specific data are the necessary next steps before practical deployment.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data and Materials Availability

All data analyzed in this study are synthetic. The Python source code, configuration files, automated tests, and generated outputs supporting the reported results are available from the corresponding author upon reasonable request.

Author Contributions

Michael J. Douglas led conceptualization, methodology, software development, formal analysis, visualization, and preparation of the original draft. Eric S. Kyper contributed to

conceptual refinement and manuscript review and editing. Both authors approved the submitted version.

Ethics and Consent

The study used no human participants, personal data, confidential case information, or animal subjects. Institutional review board approval and informed consent were therefore not applicable.

Use of Generative AI

The authors used Microsoft Copilot (Microsoft 365 Copilot, accessed October 2026) for literature-search planning, drafting and revising prose, Python code development and debugging, APA-style manuscript preparation, and creation of all manuscript figures. The authors reviewed, edited, and verified all AI-assisted content, independently evaluated the cited sources, model assumptions, analyses, and reported results, and accept full responsibility for the manuscript. No confidential participant data or human-subject data were provided to the system.

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