Scientific Research Publishing

Open Journal of Business and Management, 2024, 12, 4413-4440
https://www.scirp.org/journal/ojbm
ISSN Online: 2329-3292
ISSN Print: 2329-3284

Overcoming the Stablecoin Trilemma: Designing and Simulating a Decentralized, Stable, and Capital-Efficient Peg Maintenance System

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How to cite this paper: Kartavchenko, M., Izmaylov, M., Kartavchenko, A., Svirskii, N., Zaharov, F., Artemenko, V., Illarionova, E., Kolotushkina, L., & Krivonosov, S. (2024). Overcoming the Stablecoin Trilemma: Designing and Simulating a Decentralized, Stable, and Capital-Efficient Peg Maintenance System. *Open Journal of Business and Management, 12,* 4413-4440.
https://doi.org/10.4236/ojbm.2024.126222

Received: September 29, 2024
Accepted: November 25, 2024
Published: November 28, 2024

Abstract

The Stablecoin Trilemma—balancing stability, decentralization, and capital efficiency—remains a significant challenge in the decentralized finance (DeFi) landscape. This study introduces an innovative stablecoin system, USC, designed to overcome the inherent limitations of existing models by simultaneously achieving stability, decentralization, and capital efficiency. The USC system leverages a combination of decentralized assets, including the hypothetical native token CAPE and ETH, integrated through key components such as the Treasury, Treasury Credit Module, CAPE Bonder, and Merchant. A comprehensive Python-based simulation spanning 298 days was conducted to evaluate the system's performance under varying market conditions. ETH price movements were meticulously modeled using historical data from the Binance/USDT trading pair, with specific periods of daily growth and decline to test the system's resilience. Additionally, CAPE price determination was simulated using a hypothetical liquidity pool. The simulation results demonstrated that the USC system effectively maintained the usc_support metric above the critical threshold of 1 throughout the study period, indicating that each USC remained fully backed by the underlying assets. The Treasury Credit Module played a crucial role by offering a stable 10% Annual Percentage Rate (APR), incentivizing participants to lock their USC and thereby reducing the circulating supply during asset depreciation periods. Furthermore, the Merchant component

provided a substantial safety net with a borrowing capacity of up to 67,315 ETH (approximately $160.6 million at the simulation's final ETH price), which is nearly three and a half times the Treasury's holdings. This extensive liquidity provision enhanced the system's ability to maintain stability during significant market downturns. However, the study acknowledges several key limitations, including the lack of realistic participant behavior modeling, the absence of external shocks such as regulatory changes or technological failures, and the lack of empirical validation through real-world testing. These limitations highlight the need for further research and development to address behavioral complexities, incorporate unforeseen variables, and validate the system's performance in live environments. In conclusion, the USC stablecoin system presents a promising framework for resolving the Stablecoin Trilemma by integrating decentralized assets and innovative financial mechanisms. While the simulation results are encouraging, demonstrating robust stability, the system's practical implementation will require overcoming significant technical, regulatory, and operational challenges.

Keywords

Stablecoin Trilemma, Decentralization, Capital Efficiency, Stability, USC Stablecoin, Economic Simulation, Peg Maintenance System

1. Introduction

1.1. Problem Identification

The concept of stablecoins has revolutionized the world of cryptocurrency by offering a digital currency that strives to maintain a stable value. However, achieving stability while also ensuring decentralization and capital efficiency has proven to be a significant challenge. This issue is encapsulated in what is known as the Stablecoin Trilemma—a problem that forces stablecoins to compromise between these three essential qualities. As a result, existing stablecoins often sacrifice one of these qualities:

- Centralization: Popular stablecoins like USDC and USDT maintain stability but rely on centralized fiat reserves, sacrificing decentralization.
- Capital Inefficiency: Stablecoins like DAI use over-collateralized crypto loans, ensuring decentralization and stability but locking up excessive capital.
- Instability: Algorithmic stablecoins like Terra's UST attempt to maintain stability through supply adjustments without full collateral backing, leading to potential instability.

1.2. Why It's Important to Solve

Failing to address the Trilemma limits the potential of stablecoins and DeFi. Stablecoins that rely on centralized backing are susceptible to regulatory risks, transparency issues, and potential central points of failure. Systems that use over-collateralized loans are capital inefficient, hindering liquidity and widespread

adoption. Algorithmic stablecoins present significant risks due to their dependence on self-correcting mechanisms that can fail under extreme market conditions, causing instability and loss of investor confidence. Solving the Stablecoin Trilemma is crucial for the future of DeFi. A stablecoin that is stable, decentralized, and capital efficient can lead to wider adoption, greater liquidity, and restlessness in decentralized systems, paving the way for a truly decentralized financial ecosystem (Adams & Van Den Bergh, 2020; Allen & Wysocki, 2019).

1.3. Goal of the Study

The primary goal of this study is to solve the Stablecoin Trilemma by designing a stablecoin system that simultaneously achieves stability, decentralization, and capital efficiency without compromise. By introducing the innovative USC stablecoin system—which integrates decentralized assets, economic incentives, and inherent stability mechanisms—we aim to provide a practical solution that addresses the inherent trade-offs faced by existing stablecoins. Successfully overcoming the Trilemma would not only validate the proposed system but also offer a blueprint for the next generation of stablecoins, fostering sustainable growth in decentralized finance ecosystems (Puschmann, 2017).

1.4. The Stablecoin Trilemma Explored

Defining Stability, Decentralization, and Capital Efficiency

- Stability: The ability of a stablecoin to maintain a consistent value, usually pegged to a fiat currency like the US dollar, minimizing volatility and serving as a reliable medium of exchange and store of value.
- Decentralization: Operating without reliance on centralized authorities or intermediaries, ensuring that control and governance are distributed among a network of participants.
- Capital Efficiency: The effective use of capital where minimal assets are required to achieve a desired level of stability, avoiding the need for over-collateralization that locks up excessive funds (Stablecoins.wtf, n.d.).

1.5. Challenges in Achieving All Three

The Stablecoin Trilemma posits that existing stablecoins can typically achieve only two of the three qualities:

- Stable and Capital Efficient but Not Decentralized: Stablecoins like USDC and USDT maintain stability and are capital efficient by being fully backed by fiat reserves. However, they rely on centralized entities, compromising decentralization.
- Stable and Decentralized but Not Capital Efficient: Decentralized stablecoins like DAI achieve stability without central authorities but require over-collateralization, leading to capital inefficiency.
- Decentralized and Capital Efficient but Not Stable: Algorithmic stablecoins attempt to maintain a peg through supply adjustments without full collateral backing. While they are decentralized and capital efficient, they often fail to

maintain long-term stability, as evidenced by the collapse of Terra's UST.

2. Methods

2.1. Approach to Solving the Problem

To overcome the Stablecoin Trilemma, the USC system introduces a novel approach that balances decentralization, capital efficiency, and stability through a set of interconnected components.

2.1.1. Decentralization

No fiat money or centralized stablecoins are used to back the stablecoin's value, ensuring a purely decentralized system. Instead, USC is backed by decentralized crypto assets: a mix of CAPE (a hypothetical native token of a hypothetical purpose-built blockchain) and Ethereum (ETH). This ensures that control over the system is fully decentralized, with no reliance on centralized financial institutions or reserves.

2.1.2. Capital Efficiency

The system achieves capital efficiency by allowing users to directly exchange assets with the Treasury at a 1:1 exchange rate—issuing 1 USC for every $1 worth of the specified mix of CAPE and ETH provided. This eliminates the need for over-collateralized loans typical in other stablecoins like DAI. Furthermore, the system creates an artificial buffer zone—an over-collateralization achieved internally rather than by individual users. This buffer is established through:

- Deposits into the Treasury Credit Module: Participants lock their USC to earn interest, reducing the circulating supply and enhancing the system's collateralization.
- Loans from the Merchant: The Merchant can inject additional capital into the system by providing loans backed by its staked ETH reserves, stabilizing USC during market volatility.

By combining the 1:1 exchange rate with these internal mechanisms, the USC system maintains capital efficiency for users while ensuring sufficient over-collateralization exists—aiming for a USC backing level of 1.5 (Catalini & Gans, 2016).

2.1.3. Stability

A key focus is stability, achieved through the creation of a buffer zone in the stablecoin's backing value. This buffer helps ensure that each USC remains backed even during significant downturns in assets backing the coin. Additionally, instant liquidity injections through loans provided by the Merchant offer immediate support to stabilize the system during high volatility, making the system resilient to market shocks.

2.2. System Components

2.2.1. Treasury Module

The Treasury is responsible for issuing and redeeming USC. Users exchange a mix of 60% CAPE and 40% ETH with the Treasury to receive USC. The exchange rate is 1 USC for every $1 worth of the mix, with small fees applied.

2.2.2. Treasury Credit Module

The Treasury Credit Module allows participants to lock their USC for 90 days in exchange for an APR of up to 10%. This helps reduce the circulating supply of USC, alleviating pressure on the Treasury to back every stablecoin. The rewards pool that funds this APR comes from two sources: the CAPE Bonder and profits from Merchants. The module plays a critical role in maintaining the stability of the system by creating a buffer zone in backing value.

2.2.3. CAPE Bonder

The CAPE Bonder enables participants to bond CAPE at a 5% discount in exchange for a mix of ETH and CAPE (in the same proportion as in the Treasury). After a lock period of five days, participants can sell the CAPE for profit or loss depending on its market price. The CAPE and ETH provided by participants are then exchanged for USC in the Treasury, and the resulting USC is transferred to the Treasury Credit Module's rewards pool to support the APR (Olympus Dao Docs).

2.2.4. Merchant

The Merchant's primary function is to facilitate the flow of ETH from external blockchains into the internal system by issuing Synthetic ETH on the internal blockchain. Users deposit their ETH into the Merchant from an external blockchain like Ethereum, and in return, the Merchant mints Synthetic ETH on the internal blockchain. While Synthetic ETH operates within the system, the Merchant manages the "real" ETH externally through reserves and staking.

2.3. Functions of the Merchant

- ETH Management: Upon receiving external ETH, the Merchant allocates 30% of it to a reserve pool and stakes the remaining 70%. Staking the ETH generates daily interest, which is managed in two ways: it is both reinvested in real ETH to grow the reserves and the staked pool, and allocated to the Treasury Credit Module's rewards pool in the form of Synthetic ETH (Merchant treats ETH that is received as a profit from staking the same way as it was ETH that was brought by users).
- Lending to the Treasury: When additional backing is required for USC, the Merchant plays a pivotal role in stabilizing the system by taking an over-collateralized loan using its staked ETH as collateral. The Merchant can borrow up to 30% of its staked ETH pool. The acquired ETH flows through the Merchant before being sent to the Treasury in the form of Synthetic ETH, thus increasing both the reserves and staking pool in real ETH.

Why the Merchant Is Essential

The Merchant provides an additional layer of defense against volatility by managing real-world ETH assets outside the internal blockchain. Its ability to stake ETH not only generates returns but also bolsters the system's stability during market fluctuations. By reinvesting staking rewards and contributing to the Treasury's

backing, the Merchant enhances the system's resilience and capacity to maintain the USC peg.

2.4. The Role and Nature of CAPE in the USC System

2.4.1. CAPE: A Hypothetical Native Token

CAPE is introduced as a hypothetical native token specific to a hypothetical purpose-built blockchain designed exclusively for the USC system. It is important to note that CAPE and the associated blockchain are conceptual and have not been implemented in reality for this study. The recommendation to build the USC stablecoin on a separate blockchain stems from the necessity to incorporate unique features and mechanics that may not be feasible on existing platforms.

2.4.2. Issuance and Governance of CAPE

CAPE is envisioned to be issued through a transparent and decentralized protocol on the blockchain. Its supply would be governed by predefined algorithms or community-driven governance models, ensuring no central authority controls its issuance, aligning with the system's goal of maintaining decentralization (Wood, 2014; Schär, 2021).

2.4.3. Considerations for CAPE Issuance

It is crucial to carefully design the issuance mechanisms of CAPE to maintain its price stability, which is vital for the overall stability of the USC system. The CAPE Bonder module already introduces new CAPE into circulation by offering it at a discount to participants. While this incentivizes engagement and supports the Treasury Credit Module's rewards pool, it can exert downward pressure on CAPE's market price if not properly managed. Excessive issuance of CAPE, whether through the CAPE Bonder or other mechanisms, could lead to an oversupply, negatively impacting its price. Since CAPE is a significant part of USC's backing assets, a decline in CAPE's value could weaken the backing value and threaten the stability of USC itself.

2.4.4. Utility of CAPE beyond Backing USC

- Beyond serving as one of the assets backing USC, CAPE would have utility within the blockchain's DeFi ecosystem: Governance Participation: CAPE holders might have voting rights on protocol upgrades and governance decisions, fostering community involvement.
- Access to DeFi Services: CAPE could be used within various DeFi applications on the blockchain, such as lending, borrowing, and liquidity provision.

2.5. Necessity of a Purpose-Built Blockchain for the USC System

- Centralized Management of Real ETH Assets: By requiring users to interact with the system through the Merchant, the system ensures that all real ETH assets are managed by the system itself, allowing for effective staking, borrowing, and liquidity provision.
- Advantages of a Purpose-Built Blockchain for CAPE Demand: By creating a separate, purpose-built blockchain with CAPE as its native token, the USC

system can significantly enhance CAPE's demand. CAPE would be required for every operation within the blockchain, ensuring consistent and widespread use. This intrinsic demand supports CAPE's price stability and reduces the risk of price volatility affecting the stablecoin's backing.

2.6. Simulation Methodology and Assumptions

2.6.1. Simulation Framework

A Python-based simulation was conducted over a 298-day period to evaluate how effectively the system could maintain stability under varying market conditions. The simulation included three primary capital flows into different parts of the system, processed daily:

- **ETH to CAPE Bonder (eth_to_bonder = 20)** This flow represents the amount of ETH that participants allocate daily to purchase CAPE bonds through the CAPE Bonder module.
- **ETH to Treasury Credit Module (eth_to_bank = 100)** This flow represents the daily amount of ETH that participants deposit into the Treasury Credit Module, effectively converting their ETH into USC and locking it for a specified period to earn interest.
- **ETH for External Purposes (eth_for_third_flow = 100)** This flow accounts for the daily amount of ETH that participants convert into USC for purposes outside of the system's internal modules, such as trading, sending, storing, or interacting with decentralized applications (dApps) within the blockchain's ecosystem or outside of it.

2.6.2. Price Determination of ETH and CAPE

ETH price data was based on historical data from the Binance/USDT trading pair. The ETH price was recalculated using specific formulas that estimate the average growth or decline over predefined time periods to simulate market conditions and challenge the system's stability mechanisms. However, it is important to acknowledge that the ETH price data generated using our formulas may contain a degree of error due to the simplifications in our modeling approach, which could impact the accuracy and precision of the simulation results (Figure 1).

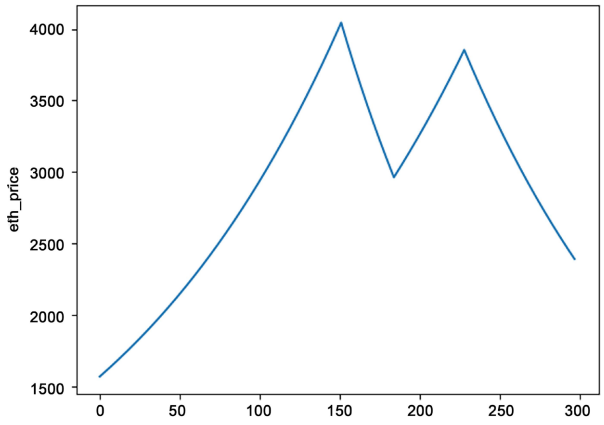

Figure 1. Simulated ETH price dynamics.

Specifically, ETH was modeled to:

- Increase in price by 0.63% daily from t = 1 to t = 151 (October 12th, 2023 to March 11th, 2024)
- Decrease in price by 0.94% daily from t = 152 to t = 184 (March 12th, 2024 to April 13th, 2024)
- Increase in price by 0.60% daily from t = 185 to t = 228 (April 13th, 2024 to May 27th, 2024)
- Decrease in price by 0.69% daily from t = 229 to t = 298 (May 28th, 2024 to August 5th, 2024)

For CAPE price determination, the simulation utilized a hypothetical liquidity pool with ample initial assets, ensuring that CAPE's price was accurately and smoothly determined within the model. In a real-world scenario, price oracles would likely be employed to obtain reliable CAPE and ETH price data. However, for the purposes of this simulation, using a hypothetical liquidity pool was the most straightforward method to achieve consistent and realistic price dynamics.

2.6.3. Assumptions Regarding Participant Behavior

- Participants are assumed to sell their bonded CAPE immediately upon the expiration of the lock period, regardless of the prevailing CAPE price. Additionally, participants are expected to deposit into the Treasury Credit Module whenever feasible.
- Consistent Participation: The simulation presumes ongoing engagement from participants, with fixed capital inflows reflecting sustained interest in the system (explanation of this assumption is provided in the section below).

2.6.4. Flows of ETH into the System Are Fixed and Always Positive

The simulation assumes that demand for deposits into the Treasury Credit Module remains consistently positive under most market conditions. This assumption is based on the system offering a 10% APR, which is higher than most traditional finance alternatives, ensuring that participants continue depositing even during market downturns. During periods of market decline, demand for these deposits is expected to be particularly strong, as USC is designed to remain stable, making it an attractive, non-volatile alternative when other cryptocurrencies and their projects' APRs are falling. Conversely, when the market is growing and alternative projects may offer higher APRs, USC's stability—designed to mimic the value of the dollar—still appeals to participants who seek security over speculative returns. The simulation also considers that testing for a bank run scenario is unnecessary, as nearly any financial system would struggle under such conditions. However, the USC system is designed with a buffer zone, indicated by the usc_support metric, which provides protection against up to a 25% drop in both ETH and CAPE prices without triggering panic. If USC maintains its $1 peg at all times, there is no rational incentive for participants to initiate a bank run. In the rare event that the usc_support metric drops below 1, Merchants would promptly recover the system's stability by issuing loans, and the high demand for deposits in the

Treasury Credit Module would continue to restore the system's balance. Thus, the assumption is that the system is resilient against typical market fluctuations, and panic-induced bank runs are highly unlikely in the simulated environment.

2.6.5. No Smart Contract Failures or External Shocks

The simulation assumes that all smart contracts function without any technical failures or exploits. Furthermore, it assumes that no external shocks, such as regulatory changes or large-scale market disruptions beyond ETH price fluctuations, impact the system's operations.

2.6.6. Assumption Regarding Market Volatility

The simulation did not incorporate scenarios involving extreme ETH price downturns. This decision was based on evidence from studies indicating a trend of decreasing volatility in cryptocurrency markets over recent years. As such, the simulation focused on replicating recent ETH price movements, which are less volatile than those observed in the earlier history of cryptocurrencies. By modeling price fluctuations that reflect current market conditions, the study aims to provide a realistic assessment of the USC system's performance under typical volatility levels. This assumption acknowledges that while extreme market crashes are possible, they are less representative of the current market environment and were thus excluded from the simulation's scope (Fidelity Digital Assets, 2022).

3. Results

3.1. USC Support Metric

The usc_support metric varied over the course of the simulation. Initial values exceeded the system's desired level of 1.5 due to an increase in the price of ETH. The metric subsequently dropped below 1.5 during periods of ETH price decline but remained above the critical threshold of 1, indicating full backing of USC (see Figure 2).

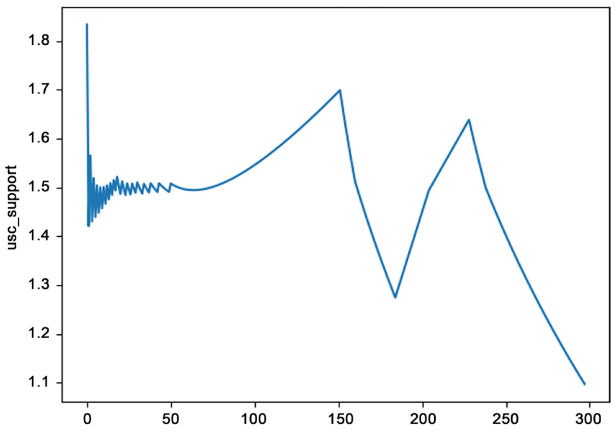

Figure 2. USC support metric fluctuations.

3.2. Treasury Credit Module Interest Rate

The interest rate within the Treasury Credit Module remained stable at 10% APR for the duration of the simulation. No deviations from this rate were observed throughout the simulation period (see Figure 3).

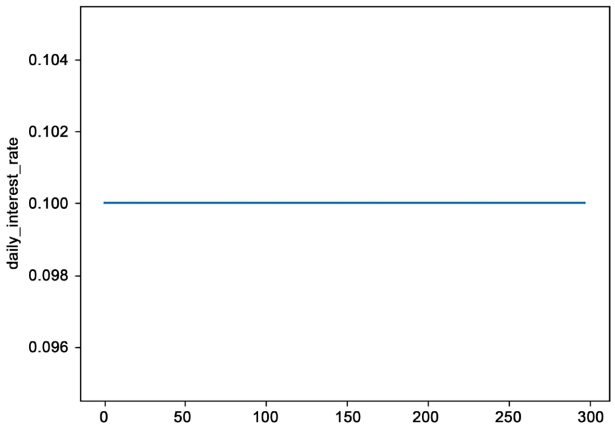

Figure 3. Treasury credit module APR stability.

3.3. Merchant and Treasury Holdings at the End of the Simulation

- The Merchant held 320551.43 ETH, with the price of ETH at $2389.74.
- The Merchant earned 20644.76 ETH through staking operations during the simulation period.
- The Treasury Credit Module had 17410324.95 USC available for withdrawal at any given moment, representing USC from deposits that had completed the 90-day lock period.
- The Treasury held 19102.17 ETH and 28525.50 CAPE. The final price of CAPE was $2414.78 (see Figure 4 for the CAPE/USD price graph).

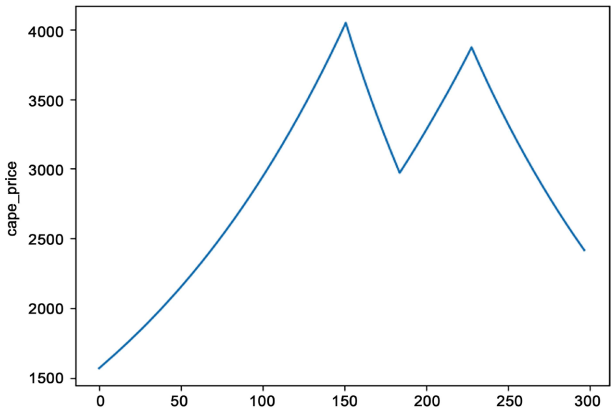

Figure 4. CAPE/USD price trends.

3.4. Borrowing Capacity from the Merchant

Based on the Merchant's holdings at the conclusion of the simulation, the Treasury could borrow up to 67,315 ETH if the usc_support metric fell below 1.

3.5. USC Held by Users for External Purposes

A total of 86923148.87 USC was held by participants outside the stablecoin system, indicating the volume of USC being used for external purposes such as trading or other activities.

4. Discussion

4.1. Interpretation of Results

The simulation results demonstrate that the proposed USC stablecoin system effectively addresses the Stablecoin Trilemma by achieving stability, decentralization, and capital efficiency simultaneously. Throughout the 298-day simulation period, the usc_support metric fluctuated but consistently remained above the critical threshold of 1. This indicates that at all times during the simulation, each USC was fully backed by the underlying assets (ETH and CAPE). The maintenance of the usc_support metric above 1 demonstrates the system's ability to withstand market downturns without compromising the full backing of USC. This consistent full backing is essential for maintaining user trust and preventing scenarios like bank runs, where a loss of confidence could lead to mass redemptions and destabilize the system. The Treasury Credit Module played a vital role in this stability by offering a stable interest rate of 10% APR. This reduced the circulating supply of USC during periods when backing assets were decreasing in value, helping to maintain the usc_support metric above 1. Moreover, the system did not need to activate emergency measures such as borrowing from the Merchant, indicating that the internal mechanisms and buffer zones were sufficient to maintain stability. However, the Merchant's potential capacity to provide additional liquidity represents a significant safety net, enhancing the system's resilience. Specifically, the Treasury could borrow up to 67,315 ETH, equivalent to approximately $160.6 million at the simulation's final ETH price of $2389.74. In comparison, the Treasury's holdings at the end of the simulation totaled 19102.17 ETH, valued at around $45.6 million. This means that the borrowing capacity from the Merchant is nearly three and a half times the Treasury's current ETH holdings, providing a robust cushion to maintain the USC stablecoin's backing and stability in the event of significant market downturns.

4.2. Key Limitations of the System

The proposed USC stablecoin system, while innovative, presents several key limitations that must be addressed to ensure its successful implementation and long-term viability. These limitations span technical, regulatory, economic, and operational aspects, each posing unique challenges:

1) Technical Implementation Challenges: Developing the USC system involves creating complex smart contracts and a new blockchain infrastructure tailored to its specific needs. Smart contracts must be meticulously coded to handle intricate financial operations, asset exchanges, and incentive mechanisms without introducing vulnerabilities. Additionally, building a purpose-built blockchain

requires significant expertise to ensure scalability, interoperability, and robustness against potential attacks. Any flaws in the smart contracts or blockchain protocol could lead to severe financial losses and undermine user trust (Ernst & Young, 2021; Buterin, 2014).

2) **Regulatory and Legal Risks:** The decentralized nature of the USC system is likely to attract scrutiny from regulatory bodies across different jurisdictions. Navigating the **complex** and evolving landscape of cryptocurrency regulations poses a significant challenge. Issues such as compliance with Anti-Money Laundering (AML) and Know Your Customer (KYC) regulations, classification of CAPE and USC as securities or commodities, and adherence to data protection laws can vary widely between countries. Furthermore, implementing necessary compliance measures could inherently compromise the system's decentralization. For instance, enforcing AML/KYC typically requires centralized data collection and verification processes, which contradicts the USC system's objective of distributing control among participants without relying on central authorities. Failure to comply with these regulations could result in legal penalties, restrictions on operations, or forced alterations to the system's design, thereby hindering its global adoption and functionality. Additionally, the need to balance regulatory compliance with maintaining decentralization presents a complex dilemma, potentially necessitating compromises that could undermine the system's foundational principles of trustlessness and distributed governance (Zhu, 2023; Van Valkenburgh, 2021; Schoenmakers & Mastrogiacomo, 2020; Kaal & Milne, 2020).

3) **Economic Sustainability of Incentives:** Maintaining a 10% APR through the Treasury Credit **Module** raises concerns about the long-term economic sustainability of the incentive structure. High interest rates require substantial and consistent revenue streams to fund the rewards. Market fluctuations, decreased staking returns, or reduced capital inflows could jeopardize the ability to sustain these incentives. If the system cannot continuously offer attractive returns, participant engagement may decline, weakening the stability mechanisms that rely on active user participation.

4) **Adoption and Network Effects:** Achieving widespread adoption is crucial for the USC system's success, as network effects significantly enhance the utility and stability of a **stablecoin**. However, penetrating a market dominated by established stablecoins like USDC, USDT, and DAI is challenging. Building a robust user base requires extensive marketing, partnerships, and trust-building measures. Without sufficient adoption, the system may struggle to achieve the necessary liquidity and capital flows to maintain the USC peg and provide effective incentives, limiting its impact on the decentralized finance ecosystem.

5) **Dependence on the CAPE Token:** The USC system's reliance on the CAPE token introduces risks associated with its hypothetical nature. As CAPE is not an established asset, its market acceptance, liquidity, and price stability remain uncertain. If CAPE fails to gain traction or experiences significant volatility, it could undermine the USC's backing ratio, compromising the stablecoin's stability and

user confidence.

6) Complexity and User Understanding: The USC system's multifaceted design, involving different components, presents a steep learning curve for users. Navigating these interconnected mechanisms requires a deep understanding of decentralized finance principles, smart contract interactions, and the specific operational workflows of the system. This complexity may deter less technically proficient users, limiting the system's accessibility and broader adoption. Simplifying user interfaces and providing comprehensive educational resources are essential to mitigate this barrier.

7) Security Risks: Despite rigorous design, the USC system remains susceptible to security threats such as smart contract exploits, hacking attempts, and technical failures. Vulnerabilities in the smart contracts could be exploited by malicious actors to drain funds or manipulate the system's mechanisms, leading to financial losses and reputational damage. Ensuring robust security measures, including regular audits, formal verification, and continuous monitoring, is imperative to protect the system from potential breaches and maintain user trust.

8) Interdependence of System Components: The USC system's components exhibit a high degree of interdependence, meaning that a failure or inefficiency in one **component** can initiate cascading effects throughout the entire system. For example, a malfunction in the CAPE Bonder could disrupt the allocation of funds to the Treasury Credit Module's rewards pool. This disruption may lead to a shortage of funds, resulting in a decrease in the APR offered to participants. A reduced APR could discourage users from making deposits into the Treasury Credit Module, thereby preventing a decrease in the circulating supply of USC and weakening the system's backing. Similarly, issues within the Merchant component could impair the provision of liquidity, making it difficult or impossible to execute emergency measures if the usc_support metric falls below 1. Such liquidity impairments would undermine the system's ability to stabilize USC during periods of market stress. Therefore, ensuring seamless integration and implementing robust fail-safes across all components are critical to preventing systemic failures and maintaining the overall stability of the USC system.

9) Dependence on a Developed DeFi Ecosystem: The effectiveness and stability of the USC **system** rely heavily on the existence of a vibrant and well-developed decentralized finance ecosystem within its own blockchain. This ecosystem encompasses lending platforms, decentralized exchanges (DEXs), and other DeFi protocols that provide essential utility and liquidity for both CAPE and USC. Without a comprehensive suite of DeFi services, funds may begin to exit the system, leading to a depletion of capital within the Merchant component. This outflow undermines the effectiveness of ETH staking, as reduced funds limit the Merchant's ability to generate staking rewards and maintain sufficient liquidity. Consequently, the system's capacity to provide emergency funds in scenarios where the usc_support metric drops below 1 is significantly impaired. Ensuring that funds remain within the system is crucial for maintaining the Merchant's liquidity

and the overall stability of USC. Therefore, developing a robust DeFi ecosystem within the USC blockchain is essential to retain capital within the Merchant, sustain effective staking operations, and ensure the system can respond adequately to fluctuations in the backing ratio.

4.3. Unobvious Advantages of the USC System

1) **Compounding Effect of the Merchant Mechanisms:** The Merchant component facilitates real ETH flows from staking profits and over-collateralized loans. They are **strategically** reinvested to compound the system's assets. Specifically, 70% of the profits generated from staking real ETH (or real ETH that was received as a result of receiving a loan) are reinvested back into staking, thereby expanding the staking pool and increasing yield generation. Simultaneously, 30% of the profits (or real ETH that was received as a result of receiving a loan) are allocated to reserve pools to ensure liquidity and provide a safety net for withdrawals. Additionally, the system mints Synthetic ETH (corresponding to newly acquired real ETH from staking profits or loans), which is either allocated to the Treasury Credit Module's rewards pool or directly to the Treasury. This dual usage approach not only amplifies the system's asset base but also reinforces the stability and incentivization mechanisms essential for maintaining the USC peg.

2) **Enhanced Borrowing Capacity through the Merchant:** The Merchant plays a pivotal role in augmenting the Treasury's borrowing capacity, which is intrinsically linked to the size and robustness of the blockchain's DeFi ecosystem. While the Treasury manages the reserves required to back USC, the Merchant oversees all funds within the blockchain's ecosystem. This division of responsibilities ensures that the Treasury can leverage the Merchant's holdings to access substantial liquidity. As the DeFi ecosystem within the blockchain expands, the Merchant's holdings grow proportionately, directly enhancing the Treasury's ability to borrow funds.

3) **Automatic Growth of Over-Collateralization Buffer during Bull Markets:** In **periods** of market growth, the USC system benefits from the natural appreciation of underlying assets, thereby enhancing its over-collateralization buffer without necessitating additional deposits. As the value of ETH or CAPE appreciates, the Treasury's holdings increase proportionately, strengthening the over-collateralization buffer. This automatic growth of the buffer zone ensures that each USC remains well-backed, sustaining its peg and reinforcing user confidence without placing additional burdens on Treasury.

4) **Attractive APR in the Treasury Credit Module:** The Treasury Credit Module offers a 10% Annual Percentage Rate (APR), which serves as a compelling incentive for participants to lock their USC and support the system's stability. This high APR is designed to surpass most traditional finance alternatives, encouraging users to deposit their USC into the Treasury Credit Module. The influx of locked funds reduces the circulating supply of USC, alleviating pressure on the Treasury to back each USC in circulation. Moreover, the attractive APR not only draws

sustained participation but also ensures a steady flow of capital into the system, which is crucial for maintaining stability and supporting the system's economic mechanisms.

4.4. Limitations of the Study Process

- Lack of Realistic Participant Behavior Modeling
- No Consideration of External Shocks
- No real-world testing.

4.5. Conclusion

The USC stablecoin system emerges as a promising solution to the longstanding Stablecoin Trilemma, adeptly balancing stability, decentralization, and capital efficiency. Through the innovative integration of its core components—Treasury, Treasury Credit Module, CAPE Bonder, and Merchant—the USC system demonstrates its capability to maintain a fully backed stablecoin, as evidenced by the usc_support metric consistently remaining above the critical threshold of 1 throughout the 298-day simulation period. This consistent backing underscores the system's resilience against market downturns, thereby fostering user confidence and potentially preventing destabilizing phenomena such as bank runs. A pivotal element contributing to this stability is the Treasury Credit Module, which offers an attractive 10% APR to participants, incentivizing the locking of USC and effectively reducing its circulating supply during periods of declining asset values. Additionally, the Merchant component serves as a significant safety net by providing substantial borrowing capacity—up to 67,315 ETH (approximately $160.6 million)—which is nearly three and a half times the Treasury's ETH holdings. This extensive liquidity provision enhances the system's ability to uphold the USC peg in the face of significant market volatility, thereby reinforcing the system's robustness. Despite these promising outcomes, the study acknowledges several key limitations that must be addressed to ensure the USC system's successful implementation and long-term viability. Furthermore, the study process itself is subject to limitations. Ultimately, the USC stablecoin system offers a compelling framework for the next generation of stablecoins, promising enhanced stability, decentralization, and capital efficiency. With continued innovation and strategic refinement, the USC system has the potential to significantly impact the decentralized finance landscape, paving the way for more resilient and trustworthy stablecoin solutions.

4.6. Future Work

Future research and development efforts should focus on:

- Dynamic Modeling of Participant Behavior: Incorporating models that account for irrational actions, emotional responses, and diverse decision-making processes.
- Incorporation of External Shocks: Evaluating the impact of regulatory changes, technological failures, and macroeconomic events.

- Empirical Validation: Deploying pilot programs or controlled environments to observe real-world performance and gather data.
- Development of the DeFi Ecosystem: Creating initial DeFi services, incentivizing developers, and building partnerships to ensure a vibrant ecosystem within the USC blockchain.
- Economic Sustainability Analysis: Examining the long-term feasibility of incentive structures and exploring adaptive mechanisms.
- Security Enhancements: Continuously improving security protocols, conducting audits, and engaging the community in safeguarding the system.
- Regulatory Engagement: Proactively working with regulators to navigate legal challenges and ensure compliance.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix I: Table with Results of the Simulation

index	eth_to_bonder	eth_to_bank	eth_price	cape_bonded	cape_price	cape_emitted	merchant.earned_eth	merchant.eth_amount	usc_to_bank	potentially_removable_usc	daily_dividends	total_dividends	daily_interest_rate	cape_fraction	usc_support	emitted_usc	treasury.total_eth_amount	treasury.total_cape_amount	already_borrowed_eth	usc_just_held_by_people
0	20	100	1566.86	79.96034263154704	1566.897492050356	0.0	67.13805479452056	300086.14141643833	156253.1621282314	0.0	42.80908551458395	42.80908551458395	0.1	0.5997981715097812	1.8330189425576051	187534.17977959008	87.80035284343506	131.5866826660931	0	156253.16246337476
1	20	0	1576.731218	79.93930081548163	1577.1839867942338	0.0	134.28867091052732	300142.2866012731	0.0	0.0	42.80908551458395	85.6181710291679	0.1	0.5998280655368874	1.4210726321316587	376249.824120534	135.70052926551634	203.3466417331947	0	313490.7191086991
2	20	100	1586.6646246733999	79.92782696177251	1587.3480810578315	0.0	201.4585615199446	300228.43756845593	158228.15250576613	0.0	86.159264283287	171.77743531245488	0.1	0.5998372458610736	1.5652829267977126	566154.3765973699	223.50088211040654	334.8798179398291	0	471718.87195389805
3	20	0	1596.6606118088423	79.90679797853116	1597.7687459708584	0.0	268.64101558777264	300284.5923046763	0.0	0.0	86.159264283287	257.93669959574186	0.1	0.5998768755999331	1.4301716355775724	757255.3269739992	271.4010585332153	406.6106005661422 4	0	630943.8614111532
4	20	100	1606.719573663238	79.89533112181213	1608.0654508991206	0.0	335.8427462860792	300370.7528238858	160228.10613549763	0.0	130.05737555328636	387.9940751490282	0.1	0.5998836726903353	1.5190404405812858	949560.2129095448	359.2014113795601	538.0903029424371	0	791171.9678899653
5	20	0	1616.8419069773163	79.87431496076692	1618.622035168904	79.96034263154704	403.057042580008	300426.917112774	0.0	0.0	130.05737555328636	518.0514507023146	0.1	0.5999256737575273	1.4393099554521291	1143076.6188360848	407.10158780309604	609.7919269184349	0	952409.5106796923
6	20	100	1627.0280109912733	79.87559663981341	1628.7932180778641	79.93930081548163	470.2906176417702	300513.0871852925	162253.33900848648	0.0	174.5103451446525	692.561795846967	0.1	0.599899893597988	1.504355141676992	1337812.1781684775	494.9019406503243	741.2391550344182	0	1114662.8500355876
7	20	0	1637.2782874605182	79.86732579661809	1639.224351231716	79.92782696177251	537.536760436653	300569.26102813095	0.0	0.0	174.5103451446525	867.0721409916196	0.1	0.5999108370395898	1.448257259660606	1533774.5712096666	542.8021170740167	812.934505129233	0	1277938.3851266708
8	20	100	1647.5931406715194	79.86860324097835	1649.5250812075217	79.90679797853116	604.8021841370111	300655.4406552411	164304.1706572913	0.0	219.52518642062273	1086.5973274122423	0.1	0.5998918514973453	1.500162559155847	1730971.527375887	630.602469921558	944.3702251926297	0	1442242.5561358405
9	20	0	1657.97297745775	79.86032942021768	1660.0890625097354	79.89533112181213	672.0801777082751	300711.62405331247	0.0	0.0	219.52518642062273	1306.122513832865	0.1	0.5999061550514629	1.4572780146712	1929410.8240469869	678.5026463454071	1016.0592949320562	0	1607581.843115593
10	20	100	1668.4182072157337	79.8616026344184	1670.5209904913368	79.87431496076692	739.3774543229432	300797.8132362969	166380.924178975	0.0	265.1090012641775	1571.2315150970426	0.1	0.5998903990904906	1.5008260335973596	2129100.288336403	766.3029991932619	1147.4834950820077	0	1773962.76765077
11	20	0	1678.9292419211927	79.85332584165963	1681.2195128164099	79.87559663981341	806.6873029465895	300854.006190884	0.0	0.0	265.1090012641775	1836.3405163612201	0.1	0.5999065589185789	1.4663543221402535	2330047.795927616	814.2031756172678	1219.166278000921	0	1941391.8916996988
12	20	100	1689.506496145296	79.85459686047167	1691.7842677826857	79.86732579661809	874.0164367518558	300940.20493102557	168483.92721755125	0.0	311.26898132378057	2147.609497685001	0.1	0.5998925641698892	1.5041216644026407	2532261.272866665	902.0035284654365	1350.57894973387	0	2109875.8192781433
13	20	0	1700.1503870710114	79.84632115947528	1702.6189587764682	79.86860324097835	941.3581447044597	300996.40744341136	0.0	0.0	311.26898132378057	2458.8784790087816	0.1	0.5999098591259326	1.4754784474342362	2735748.6943830666	949.9037048895992	1422.2554448415758	0	2279421.1952855783
14	20	100	1710.8613345095587	79.84759201304612	1713.318188650353	79.86032942021768	1008.7191399771865	301082.6157419932	170613.51155955944	0.0	358.01240914831743	2816.890888157099	0.1	0.5998969160725756	1.5090115796697396	2940518.086705544	1037.7040577380817	1553.6565896823304	0	2450034.7072105007
15	20	0	1721.639760916969	79.8393174023128	1724.2907814264354	79.8616026344184	1076.0927115358973	301138.8278134608	0.0	0.0	358.01240914831743	3174.903297305417	0.1	0.599914965627347	1.4846465373938704	3146577.5258681965	1085.6042341624013	1625.326797809219	0	2621723.083941926
16	20	100	1732.4860914107458	79.84058808957538	1735.1261978757987	79.85332584165963	1143.4855725535208	301225.04567176604	172770.01318413788	0.0	405.34665933575246	3580.2499566411693	0.1	0.5999026959813346	1.5149463519844961	3353935.1395489695	1173.4045870111972	1756.7164172781631	0	2794493.0974960695
17	20	0	1743.4007537866335	79.83231456760802	1746.2384476064574	79.85459686047167	1210.8910119960622	301281.2673035988	0.0	0.0	405.34665933575246	3985.596615976922	0.1	0.5999212761958094	1.4938564604905538	3562599.1058600163	1221.3047634356737	1828.3803392521804	0	2968351.5618127664
18	20	100	1754.3841785354891	79.8335850875245	1757.2117840792034	79.84632115947528	1278.3157430365934	301367.494722911	174953.77231747302	0.0	453.27919969670404	4438.875815673626	0.1	0.59990945968779	1.5216078883930328	3772577.655210749	1309.1051162847834	1959.7584348653909	0	3143305.334504453
19	20	0	1765.4367988602626	79.82531265389039	1768.465468254631	79.84759201304612	1345.753054641263	301423.7259163924	0.0	0.0	453.27919969670404	4892.15501537033	0.1	0.5999284294754841	1.5031069342938228	3983879.0690827733	1357.0052927094166	2031.4160715134349	0	3319361.3156376695
20	20	0	1776.559050693082	79.82658300648625	1779.5784802410894	79.8393174023128	1413.2029476545197	301479.9608842964	0.0	0.0	453.27919969670404	5345.4342150670345	0.1	0.5999192401840615	1.4865880860471703	4196511.681914812	1404.9054691340214	2103.0748485040385	0	3496526.449502475
21	20	100	1787.7513727124485	79.82785186870433	1790.761360122891	79.84058808957538	1480.6721352496363	301566.2016405749	178281.27387721222	0.0	502.12338432059784	5847.557599387633	0.1	0.5999085314505188	1.5122925651817039	4410483.880260269	1492.7058219833878	2234.4435097650858	0	3674807.723761145
22	20	0	1799.014206360537	79.81958032632342	1802.229898619749	79.83231456760802	1548.1539063929613	301622.4461719179	0.0	0.0	502.12338432059784	6349.680983708231	0.1	0.5999282326326716	1.4976179459281318	4625804.103109134	1540.6059984081494	2306.0960007414687	0	3854212.169714789
23	20	0	1810.3479958606083	79.82084902163975	1813.5551213869971	79.8335850875245	1615.648261929144	301678.69447857875	0.0	0.0	502.12338432059784	6851.804368028829	0.1	0.5999196744913899	1.4843484615320854	4842480.843415474	1588.5061748328824	2377.7496305728564	0	4034746.863729502
24	20	100	1821.7531882345302	79.82211774756315	1824.951511680959	79.82531265389039	1683.161915031657	301764.94857450953	181672.06224965974	0.0	551.8965520602306	7403.70092008906	0.1	0.5999096982529717	1.5083064128072476	5060522.647239554	1676.3065276825055	2509.1088559969794	0	4216418.926368174
25	20	0	1833.2302333204077	79.81384557644688	1836.639041644548	79.82658300648625	1750.6881546670495	301821.20644640015	0.0	0.0	551.8965520602306	7955.59747214929	0.1	0.5999299211239111	1.496378419604229	5279938.11407455	1724.2067041073954	2580.7561991274124	0	4399235.522662096
26	20	0	1844.7795837903261	79.81511413578458	1848.1804926996965	79.82785186870433	1818.226981680171	301877.4680945041	0.0	0.0	551.8965520602306	8507.494024209522	0.1	0.5999218089595594	1.4854865484492217	5500735.89840522	1772.1068805322568	2652.4046809907304	0	4583203.863565085
27	20	100	1856.4016951682052	79.81638272539901	1859.7944700690164	79.81958032632342	1885.785109244695	301963.7355327734	185127.3411070864	0.0	602.6163715416242	9110.110395751146	0.1	0.599912340416385	1.5079607976042173	5722924.708832055	1859.9072333821368	2783.754469095147	0	4768331.205068411
28	20	0	1868.0970258477648	79.80811144622834	1871.7051376797035	79.82084902163975	1953.3558263273703	302020.00674789824	0.0	0.0	602.6163715416242	9712.7267672927 7	0.1	0.59993294376854 1	1.498092999040896	5946513.308404981	1907.8074098071552	2855.3966649358626	0	4954624.848477513
29	20	0	1879.8660371106057	79.80937986882795	1883.466945370242	79.82211774756315	2020.939133773247	302076.281740132	0.0	0.0	602.6163715416242	10315.343138834394	0.1	0.5999251612255028	1.4890116985721813	6171510.51621063	1955.707586232145	2927.0399993867613	0	5142092.141893592
30	20	100	1891.7091931444024	79.81064832194573	1895.3026640996645	79.81384557644688	2088.541744756199	302162.5625234269	188648.3370142909	0.0	654.3008474359505	10969.643986270345	0.1	0.5999160568863513	1.5102207153464065	6397925.206481367	2043.5079390822818	3058.380351189524	0	5330740.479311716
31	20	0	1903.6269610612121	79.80237793408196	1907.4407294691707	79.81511413578458	2156.156948243176	302218.847084473	0.0	0.0	654.3008474359505	11623.944833706295	0.1	0.5999369491452191	1.50195208894003 6	6625766.308934388	2091.408115507429	3130.017400295241	0	5520577.300903202
32	20	0	1915.6198109158977	79.80364622000123	1919.4271009572135	79.81638272539901	2223.784745079428	302275.1354235239	0.0	0.0	654.3008474359505	12278.245681142245	0.1	0.5999294176890694	1.494293490550036	6855042.810389469	2139.3082919325475	3201.655587888439	0	5711610.094525196
33	20	0	1927.6882157246678	79.80491453619	1931.4887946468923	79.80811144622834	2291.425136110262	302331.42754083313	0.0	0.0	654.3008474359505	12932.546528578196	0.1	0.5999221323905745	1.4872904042281632	7085763.753860618	2187.2084683576377	3273.294913996244	0	5903846.394801742
34	20	100	1939.8326514837331	79.8061813630858	1943.6263208683933	79.80937986882795	2359.0848345098093	302417.725450353	193447.38860931073	0.0	707.3001319864464	13639.846660564643	0.1	0.5999136876664224	1.507318108146928	7317938.239332559	2275.0088212079745	3404.627915152698	0	6097293.7838247465
35	20	0	1952.0535971880806	79.79791166962714	1956.0738592083683	79.81064832194573	2426.7571292452762	302474.02713877364	0.0	0.0	707.3001319864464	14347.14679255109	0.1	0.5999350248130264	1.5009141021401051	7551575.423687508	2322.908997633221	3476.260955078993	0	6291959.891037673
36	20	0	1964.3515348503654	79.79917984932199	1968.3658425104195	79.80237793408196	2494.442021162171	302530.33260634873	0.0	0.0	707.3001319864464	15054.446924537537	0.1	0.5999278952643994	1.4949441190095096	7786684.522361859	2370.8091740584396	3547.895133397309	0	6487852.39478168
37	20	0	1976.7269495199228	79.80044653978166	1980.7351061921001	79.80364622000123	2562.1395111060574	302586.6418533319	0.0	0.0	707.3001319864464	15761.747056523984	0.1	0.5999209768787459	1.489473970333544	8023274.808416156	2418.7093504836294	3619.5304487709654	0	6684979.021355499
38	20	100	1989.1803293018982	79.80171326076402	1993.182098400741	79.80491453619	2629.8563122513233	302672.95689367544	198368.52395296036	0.0	761.6476727954768	16523.39472931946	0.1	0.5999130007988069	1.5084738640207098	8261355.613331151	2506.5097033341663	3750.8560973996064	0	6883347.545732988
39	20	0	2001.7121653765	79.79344426217007	2005.9470002710148	79.8061813630858	2697.5857135654333	302729.27571406966	0.0	0.0	761.6476727954768	17285.042402114937	0.1	0.5999346705208638	1.503469196153015	8500936.326931898	2554.409879759513	3822.485127120395	0	7082965.7914437745
40	20	0	2014.322952018372	79.7947123354973	2018.552387671982	79.79791166962714	2765.327715894152	302785.5983147683	0.0	0.0	761.6476727954768	18046.690074910413	0.1	0.5999278425187498	1.498779345104575	8742026.399087723	2602.3100561848314	3894.1152951377444	0	7283841.6321596345
41	20	0	2027.0131866160878	79.79597891997483	2031.2370258449664	79.79917984932199	2833.082320083301	302841.92469602503	0.0	0.0	761.6476727954768	18808.33774770589	0.1	0.5999211967350524	1.4944827376749708	8984635.33875804	2650.2102326101217	3965.746600115206	0	7485982.990729446
42	20	0	2039.783369691769	79.79724553472715	2044.0013743657519	79.80044653978166	2900.8495269787586	302898.2548580937	0.0	0.0	761.6476727954768	19569.985420501365	0.1	0.5999147191432128	1.490552371142145	9228772.714808458	2698.1104090353833	4037.3790420800215	0	7689397.839916198
43	20	100	2052.634004920827	79.79851217967368	2056.8459341392536	79.80171326076402	2968.636049755227	302984.5908149266	204696.36235646103	0.0	817.7288679616306	20387.714288462998	0.1	0.5999073580753236	1.5085657114517979	9474448.156388408	2785.910761886064	4168.699423139449	0	7894094.202710946
44	20	0	2065.5655991518283	79.79024367862696	2070.018552918217	79.79344426217007	3036.435177380484	303040.93055321416	0.0	0.0	817.7288679616306	21205.44315642463	0.1	0.5999294384044366	1.504985560434946	9721671.35285287	2833.8109383114825	4240.325579829747	0	8100080.152209119
45	20	0	2078.5786624264847	79.7915101568569	2083.0266067954035	79.7947123354973	3104.2469107006095	303097.2740732102	0.0	0.0	817.7288679616306	22023.172024386262	0.1	0.599922994063367	1.501614542000063	9970452.055516182	2881.71111473687 3	4311.952873384696	0	8307363.813247851
46	20	0	2091.6737079997715	79.79277666548128	2096.1164033725545	79.79597891997483	3172.071250561739	303153.62137516856	0.0	0.0	817.7288679616306	22840.900892347894	0.1	0.5999166980359325	1.4985409629355777	10220800.076668164	2929.6112911622345	4383.581303831772	0	8515953.36141062
47	20	0	2104.85125236017	79.79404320429704	2109.288456326049	79.79724553472715	3239.9081978100644	303209.97245934303	0.0	0.0	817.7288679616306	23658.629760309526	0.1	0.5999105431686849	1.4957466340610233	10472725.2904153	2977.511467587568	4455.210871197865	0	8725857.02378624
48	20	0	2118.111815250039	79.7953097731825	2122.543282553875	79.79851217967368	3307.7577532918353	303266.3273259876	0.0	0.0	817.7288679616306	24476.35862827116	0.1	0.5999045227602483	1.4932148507581564	10726237.633071432	3025.4116440128732	4526.841575510101	0	8937083.079294918
49	20	0	2131.455919686114	79.79657637238353	2135.8814022021907	79.79024367862696	3375.6199178533575	303322.685975356	0.0	0.0	817.7288679616306	25294.08749623279	0.1	0.5998986305267704	1.4909302445123067	10981347.103549186	3073.3118204381 5	4598.473416795605	0	9149639.859013572
50	20	100	2144.8840919801364	79.79784148291576	2149.303379591843	79.7915101568569	3443.5014046697615	303409.0504214009	213895.88703408244	0.0	876.3304808476806	26170.417977080473	0.1	0.5998921420143676	1.5079091017871697	11238063.763754182	3161.121732888605	4729.79269418353 2	0	9363535.746505259
51	20	0	2158.396861759611	79.78957156780686	2163.0681620234445	79.79277666548128	3511.395502709253	303465.41865081276	0.0	0.0	876.3304808476806	27046.748457928155	0.1	0.5999147802986722	1.5058731893747785	11496397.738502832	3209.012349714294	4801.418247547816	0	9578779.177688625
52	20	0	2171.9947619886966	79.79083803071151	2176.6609423453683	79.79404320429704	3579.302212818339	303521.7906638455	0.0	0.0	876.3304808476806	27923.078938775838	0.1	0.5999088548717205	1.5039489017356975	11756359.21735648	3256.9125261396994	4873.04493776313	0	9795378.642550107
53	20	0	2185.6783289892255	79.79210452380632	2190.3391397996893	79.7953097731825	3647.221535843583	303578.16646075307	0.0	0.0	876.3304808476806	28799.40941962352	0.1	0.5999030458853851	1.5022325019218628	12017958.453591501	3304.81270256507 6	4944.672764856601	0	10013342.684102317
54	20	0	2199.4481024618576	79.79337104709212	2204.103291146561	79.79657637238353	3715.1534726316054	303634.54604178946	0.0	0.0	876.3304808476806	29675.739900471202	0.1	0.5998973483513917	1.5007129985684582	12281205.76507966	3352.7128789904245	5016.301728855236	0	10232679.899178594
55	20	0	2213.3046255073673	79.79463760044716	2217.9539365191195	79.79784148291576	3783.0980240290833	303690.9294072087	0.0	0.0	876.3304808476806	30552.070381318885	0.1	0.5998917575623395	1.4993801851438853	12546111.534695312	3400.613055415745	5087.931829786045	0	10453398.938772582
56	20	0	2227.2484446480635	79.79590418391352	2231.8916194514472	79.78957156780686	3851.055190882751	303747.31655726477	0.0	0.0	876.3304808476806	31428.400862166567	0.1	0.5998862690729334	1.4982245711031688	12812686.210725404	3448.5132318410365	5159.563067676034	0	10675508.508379068
57	20	0	2241.280109849346	79.79716927840592	2245.9169296310156	79.79083803071151	3919.0249740393992	303803.7074922118	0.0	0.0	876.3304808476806	32304.73134301425	0.1	0.5998808831862239	1.4972373370155716	13080940.307280103	3496.4134082663	5231.195441188524	0	10899017.368337275
58	20	0	2255.4001745413966	79.79843440322537	2260.03037521776	79.79210452380632	3987.0073743458756	303860.1022123037	0.0	0.0	876.3304808476806	33181.06182386193	0.1	0.5998755913598034	1.4964102282896379	13350884.404709436	3544.313584691535	5302.828950350871	0	11123934.334177122
59	20	0	2269.6091956410073	79.79969955849516	2274.2325100549992	79.79337104709212	4055.0023926490853	303916.5007177947	0.0	0.0	876.3304808476806	34057.39230470961	0.1	0.599870389832506	1.495735556359481	13622529.150019648	3592.2137611167423	5374.463595190435	0	11350268.276966106
60	20	0	2283.9077335735456	79.80096474397104	2288.523891466392	79.79463760044716	4123.010029795989	303972.90300893877	0.0	0.0	876.3304808476806	34933.72278555729	0.1	0.5998652750410036	1.4952061365651597	13895885.257292323	3640.1139375419207	5446.099375734222	0	11578028.123659188
61	20	0	2298.296352295059	79.80222995989885	2302.905080277812	79.79590418391352	4191.030286633605	304029.30908599007	0.0	0.0	876.3304808476806	35810.053266404975	0.1	0.5998602436070017	1.4948152475111822	14170963.508108826	3688.014113967071	5517.7362920097075	0	11807222.857451674
62	20	0	2312.775619314518	79.80349520603428	2317.3766408393535	79.79716927840592	4259.06316400901	304085.7189492027	0.0	0.0	876.3304808476806	36686.38374725266	0.1	0.5998552923253433	1.4945565942957748	14447774.75197342	3735.914290392193	5589.374344043899	0	12037861.51813247
63	20	0	2327.3461057161994	79.80476048229684	2331.939141054545	79.79843440322537	4327.108662769333	304142.1325988308	0.0	0.0	876.3304808476806	37562.71422810034	0.1	0.5998504181538095	1.494424275189966	14726329.906743007	3783.8144668172863	5661.013531863922	0	12269953.202441571
64	20	0	2342.0083861822113	79.80602578868732	2346.593152388632	79.79969955849516	4395.166783761765	304198.55003512854	0.0	0.0	876.3304808476806	38439.04470894802	0.1	0.5998456182015208	1.4944127513847179	15006639.959056726	3831.7146432423515	5732.653855496785	0	12503507.064428164
65	20	0	2356.7630390151594	79.80729112508408	2361.3392498979356	79.80096474397104	4463.237527833552	304254.97125835007	0.0	0.0	876.3304808476806	39315.375189795705	0.1	0.5998408897202824	1.49451681949592	15288715.964769265	3879.6148196673885	5804.2953149693785	0	12738532.315811943
66	20	0	2371.6106461609547	79.80855649161042	2376.1780122524237	79.80222995989885	4531.320895831996	304311.3962687496	0.0	0.0	876.3304808476806	40191.70567064339	0.1	0.599836230095903	1.49473158652913 3	15572569.049387747	3927.514996092397	5875.937910308829	0	12975038.226346718
67	20	0	2386.551793231769	79.8098218881447	2391.1100217584158	79.80349520603428	4599.416888604455	304367.82506658137	0.0	0.0	876.3304808476806	41068.03615149107	0.1	0.5998316368401068	1.4950524470533937	15858210.40850944	3975.415172517377	5947.581641542027	0	13213034.124185469
68	20	0	2401.587069529129	79.81108731481027	2406.1358643814365	79.80476048229684	4667.525506998348	304424.25765209954	0.0	0.0	876.3304808476806	41944.36663233875	0.1	0.599827107583056	1.4954750623598565	16145651.308264151	4023.3153489423285	6019.2265086959815	0	13452529.39624854
69	20	0	2416.7170680671625	79.81235277173047	2421.256129769209	79.80602578868732	4735.646751861146	304480.69402555836	0.0	0.0	876.3304808476806	42820.697113186434	0.1	0.5998226400663877	1.495995341406874	16434903.085758585	4071.2155253672518	6090.872511797817	0	13693533.488593873
70	20	0	2431.9423855959853	79.81361825866105	2436.471411274794	79.80729112508408	4803.780624040381	304537.13418721216	0.0	0.0	876.3304808476806	43697.027594034116	0.1	0.5998182321367264	1.4966094233753746	16725977.149522942	4119.11570179214 7	6162.519650874543	0	13936055.906789858
71	20	0	2447.26362262524	79.81488377560278	2451.7823059798725	79.80855649161042	4871.927124383638	304593.5781373151	0.0	0.0	876.3304808476806	44573.3580748818	0.1	0.5998138817396567	1.497313661677948	17018884.97996116	4167.015878217014	6234.167925953167	0	14180106.21628997
72	20	0	2462.681383447779	79.81614932267901	2467.1894147181783	79.8098218881447	4940.086253738563	304650.0258761216	0.0	0.0	876.3304808476806	45449.68855572948	0.1	0.5998095869140999	1.4981046092822752	17313638.12980344	4214.9160546418525	6305.81733706058	0	14425694.042809468
73	20	0	2478.1962761635	79.81741489976801	2482.6933420990736	79.81108731481027	5008.258012952855	304706.47740388586	0.0	0.0	876.3304808476806	46326.01903657716	0.1	0.5998053457870852	1.4989790052245282	17610248.224562753	4262.816231066662	6377.467884223908	0	14672829.072706483
74	20	0	2493.80891270333	79.81868050711566	2498.294696531276	79.81235277173047	5076.442402874272	304762.93272086227	0.0	0.0	876.3304808476806	47202.349517424846	0.1	0.5998011565688438	1.499933762201757	17908726.96299252	4310.7164074914435	6449.119567470159	0	14921521.053362336
75	20	0	2509.519908853361	79.8199461444777	2513.994090246733	79.81361825866105	5144.639424350629	304819.3918273052	0.0	0.0	876.3304808476806	48078.67999827253	0.1	0.5997970175482438	1.500965955143802	18209086.1175483	4358.616583916197	6520.772386826342	0	15171779.79356743
76	20	0	2525.329884279137	79.82121181197746	2529.7921393246475	79.81488377560278	5212.849078229798	304875.85472346895	0.0	0.0	876.3304808476806	48955.01047912021	0.1	0.5997929270885186	1.5020728106757215	18511337.53485214	4406.51676034092 2	6592.426342319464	0	15423615.163907258
77	20	0	2541.2394625500956	79.82247750961577	2545.6894637156565	79.81614932267901	5281.071365359706	304932.32140960795	0.0	0.0	876.3304808476806	49831.34095996789	0.1	0.5997888836232744	1.5032516973908105	18815493.136160083	4454.416936765619	6664.081433976651	0	15677037.097152295
78	20	0	2557.249271164161	79.82374323727082	2561.6866872661526	79.81741489976801	5349.306286588339	304988.79188597656	0.0	0.0	876.3304808476806	50707.671440815575	0.1	0.5997848856527317	1.5045001168624152	19121564.91783121	4502.317113190287	6735.737661824678	0	15932055.588648878
79	20	0	2573.3599415724952	79.82500899506604	2577.784437742769	79.81868050711566	5417.55384276374	305045.26615282916	0.0	0.0	876.3304808476806	51584.00192166326	0.1	0.5997809317402456	1.5058156953298039	19429564.951802544	4550.217289614928	6807.39502589067	0	16188680.696714623
80	20	0	2589.572109204402	79.82627478287968	2593.9833468570155	79.8199461444777	5485.814034734008	305101.74421042023	0.0	0.0	876.3304808476806	52460.33240251094	0.1	0.599777020509007	1.5071961759999706	19739505.38606433	4598.117466039539	6879.053526201751	0	16446922.543034852
81	20	0	2605.8864134923897	79.82754060095755	2610.284050290066 7	79.82121181197746	5554.086863347298	305158.2260590042	0.0	0.0	876.3304808476806	53336.66288335862	0.1	0.5997731506389554	1.5086394119127222	20051398.445138834	4646.017642464122	6950.71316278493	0	16706791.313060598
82	20	0	2622.3034978973915	79.82880644905546	2626.6871877177023	79.82247750961577	5622.372329451824	305214.7116988355 4	0.0	0.0	876.3304808476806	54212.993364206304	0.1	0.5997693208638879	1.510143359321527	20365256.43056283	4693.917818888677	7022.373935667216	0	16968297.256411847
83	20	0	2638.824009934145	79.83007232729675	2643.193402835417	79.82374323727082	5690.670433895856	305271.20113016875	0.0	0.0	876.3304808476806	55089.32384505399	0.1	0.5997655299687411	1.511706071547187	20681091.72137277	4741.817995313204	7094.035844875616	0	17231450.68728088
84	20	0	2655.44860119673	79.83133823555961	2659.8033433836767	79.82500899506604	5758.98117752772	305327.6943532583	0.0	0.0	876.3304808476806	55965.65432590167	0.1	0.5997617767870314	1.5133256932653802	20998916.774592713	4789.7181717377025	7165.698890437023	0	17496261.98483939
85	20	0	2672.1779273842694	79.83260417396747	2676.517661173335	79.82627478287968	5827.3045611958005	305384.19136835873	0.0	0.0	876.3304808476806	56841.98480674935	0.1	0.5997580601984657	1.5150004551927172	21318744.125726916	4837.618348162172	7237.363072378677	0	17762741.593648482
86	20	0	2689.0126483267904	79.83387014239851	2693.3370121112143	79.82754060095755	5895.640585748538	305440.69217572454	0.0	0.0	876.3304808476806	57718.31528759703	0.1	0.5997543791266553	1.5167286691393647	21640586.389252376	4885.518524586613	7309.028390727472	0	18030900.02406937
87	20	0	2705.9534280112493	79.83513614109867	2710.262056225845	79.82880644905546	5963.989252034431	305497.1967756103	0.0	0.0	876.3304808476806	58594.645768444716	0.1	0.599750732537005	1.518508723398915	21964456.259117916	4933.418701011026	7380.69484551053	0	18300747.852678537
88	20	0	2723.00093460772	79.83640216982369	2727.2934576933594	79.83007232729675	6032.350560902033	305553.7051682706	0.0	0.0	876.3304808476806	59470.9762492924	0.1	0.5997471194346883	1.5203390784491244	22290366.509243615	4981.318877435411	7452.362436754745	0	18572295.72268491
89	20	0	2740.1558404957486	79.83766822869688	2744.431884863566	79.83133823555961	6100.724513199957	305610.21735396	0.0	0.0	876.3304808476806	60347.30673014008	0.1	0.5997435388627669	1.5222182629392338	22618329.99402556	5029.219053859768	7524.031164487125	0	18845554.34434962
90	20	0	2757.418822290872	79.83893431771908	2761.67801028617	79.83260417396747	6169.111109776871	305666.73333293304	0.0	156253.1621282314	876.3304808476806	61223.63721098776	0.1	0.599739989900407	1.5241448699418798	22948359.64884317	5077.119230284096	7595.701028734911	0	19120534.49540909
91	20	0	2774.7905608713045	79.84020043676851	2779.0325107371655	79.83387014239851	6237.5103514815	305723.2531054444	0.0	156253.1621282314	876.3304808476806	62099.967691835445	0.1	0.599736471661175	1.5261175534494982	23280468.490567807	5125.019406708396	7667.372029524995	0	19397247.021498848
92	20	0	2792.271741404794	79.8414665859685	2796.4960672453954	79.83513614109867	6305.922239162627	305779.7766717488	0.0	314481.3146339975	876.3304808476806	62976.29817268313	0.1	0.5997329832914595	1.5281350250967158	23614669.618077435	5172.919583132667	7739.044166884385	0	19675702.836581916

93	20	0	2809.863053375644	79.84273276531991	2814.0693651192723	79.83640216982369	6374.346773669092	305836.3040321007	0.0	314481.3146339975	876.3304808476806	63852.62865353081	0.1	0.5997295239689665	1.5301960510919836	23950976.212773275	5220.81975955691	7810.717440840206	0	19955912.923379615
94	20	0	2827.5651906119106	79.84399897470097	2831.753093973676	79.83766822869688	6442.78395584979	305892.83518675494	0.0	474709.42076949513	876.3304808476806	64728.95913437849	0.1	0.5997260929012893	1.5322994493430295	24289401.539099053	5268.719935981125	7882.391851419467	0	20237888.33380441
95	20	0	2845.3788513127656	79.84526521423503	2849.5479477570148	79.83893431771908	6511.233786553676	305949.3701359661	0.0	474709.42076949513	876.3304808476806	65605.28961522617	0.1	0.5997226893245664	1.5344440867619544	24629958.945064485	5316.620112405311	7954.067398649175	0	20521640.189395487
96	20	0	2863.304738076036	79.84653148392292	2867.45462477845	79.84020043676851	6579.6962666297595	306005.90887998894	0.0	636962.7597779816	876.3304808476806	66481.62009607385	0.1	0.599719312502207	1.5366288767370404	24972661.86277176	5364.52028882947	8025.744082556339	0	20807179.681757733
97	20	0	2881.343557925915	79.84779778364287	2885.473827735311	79.8414665859685	6648.171396927109	306062.45141907816	0.0	636962.7597779816	876.3304808476806	67357.95057692153	0.1	0.599715961723689	1.538852776759352	25317523.808945637	5412.420465253599	8097.421903168084	0	21094518.07300381
98	20	0	2899.496022340848	79.84906411364078	2903.6062637406576	79.84273276531991	6716.659178294847	306118.9977534885	0.0	801266.9304352729	876.3304808476806	68234.28105776921	0.1	0.5997126363034087	1.5411147861932029	25664558.38546591	5460.3206416777	8169.100860511418	0	21383666.696196683
99	20	0	2917.7628472815954	79.85033047354985	2921.8526443510377	79.84399897470097	6785.159611582158	306175.5478834747	0.0	801266.9304352729	876.3304808476806	69110.6115386169	0.1	0.5997093355795975	1.5434139441803973	26013779.279903874	5508.220818101773	8240.780954613234	0	21674636.955798294
100	20	0	2936.1447532194693	79.8515968637385	2940.213685594405	79.84526521423503	6853.672697638278	306232.1018092915	0.0	967647.8546142478	876.3304808476806	69986.94201946458	0.1	0.5997060589133094	1.5457493276689465	26365200.266063552	5556.120994525818	8312.462185500772	0	21967440.328118697
101	20	0	2954.6424651647517	79.8528632839624	2958.6901079982194	79.84653148392292	6922.198437312503	306288.6595311938	0.0	967647.8546142478	876.3304808476806	70863.27250031226	0.1	0.5997028056874244	1.5481200495578271	26718835.204522897	5604.021170949834	8384.144553200924	0	22262088.361768354
102	20	0	2973.2567126952895	79.85412973446752	2977.282636617722	79.84779778364287	6990.736831454186	306345.2210494363	0.0	1136131.781831799	876.3304808476806	71739.60298115994	0.1	0.5996995753057457	1.5505252569497332	27074698.043182544	5651.921347373822	8455.828057740931	0	22558592.67811432
103	20	0	2991.9882299852698	79.8553962150095	2995.9920010643837	79.84906411364078	7059.287880912736	306401.78636427387	0.0	1136131.781831799	876.3304808476806	72615.93346200763	0.1	0.5996963671920994	1.5529641295047254	27432802.817813866	5699.821523797781	8527.512699147686	0	22856964.97173792
104	20	0	3010.8377558341767	79.85666272558922	3014.8189355345394	79.85033047354985	7127.851586537619	306458.35547596135	0.0	1306745.2933913586	876.3304808476806	73492.26394285531	0.1	0.5996931807895114	1.555435877887904	27793163.652613584	5747.721700221712	8599.19847744808	0	23157217.010896336
105	20	0	3029.806033695932	79.85792926632999	3033.7641788382016	79.8515968637385	7196.42794917836	306514.9283847536	0.0	1306745.2933913586	876.3304808476806	74368.59442370299	0.1	0.5996900155594233	1.5579397423049588	28155794.76076192	5795.621876645615	8670.885392669355	0	23459360.637987476
106	20	0	3048.893811708216	79.85919583723263	3052.8284744280477	79.8528632839624	7265.016969684538	306571.5050909054	0.0	1479515.3065754964	876.3304808476806	75244.92490455067	0.1	0.5996868709809228	1.560474991119899	28520710.444981426	5843.52205306949	8742.57344483852	0	23763407.770015653
107	20	0	3068.101842721978	79.86046243817538	3072.012570428597	79.85412973446752	7333.618648905791	306628.0855946718	0.0	1479515.3065754964	876.3304808476806	76121.25538539836	0.1	0.5996837465500318	1.5630409195495403	28887925.098101806	5891.422229493336	8814.26263398258	0	24069370.399062663
108	20	0	3087.4308843311264	79.86172906940415	3091.317219665567	79.8553962150095	7402.232987691813	306684.6698963076	0.0	1654469.0788929695	876.3304808476806	76997.58586624604	0.1	0.5996806417790276	1.5656368484298684	29257453.20362795	5939.322405917153	8885.952960128663	0	24377260.592760064
109	20	0	3106.8816989024126	79.86299573067464	3110.743179695417	79.85666272558922	7470.859986892357	306741.25799606775	0.0	1654469.0788929695	876.3304808476806	77873.91634709372	0.1	0.5996775561957867	1.5682621230497225	29629309.336310476	5987.222582340943	8957.644423303776	0	24687090.494765844
110	20	0	3126.4550536054976	79.86426242223277	3130.291212835075	79.85792926632999	7539.49964735723	306797.8498942072	0.0	1654469.0788929695	876.3304808476806	78750.2468279414	0.1	0.599674489343172	1.5709161120475021	30003508.162721287	6035.122758764704	9029.337023535045	0	24998872.325242687
111	20	0	3146.151720443212	79.86552914371168	3149.962086191853	79.85919583723263	7608.151969936299	306854.44559098093	0.0	1832750.3527701818	876.3304808476806	79626.57730878908	0.1	0.5996714407784336	1.5735982063670266	30380064.441830963	6083.022935188436	9101.03076084936	0	25312618.381340656
112	20	0	3165.972476282004	79.86679589547983	3169.7565716935483	79.86046243817538	7676.816955479487	306911.0450866439	0.0	1832750.3527701818	876.3304808476806	80502.90778963677	0.1	0.5996684100726625	1.5763078182687844	30758993.0255927	6130.923111612141	9172.725635273964	0	25628341.03768187
113	20	0	3185.9181028825806	79.86806267729288	3189.675446118737	79.86172906940415	7745.494604836772	306967.6483814511	0.0	1832750.3527701818	876.3304808476806	81379.23827048445	0.1	0.5996653968102361	1.5790443803933079	31140308.859525897	6178.823288035817	9244.421646835748	0	25946052.7468482
114	20	0	3205.9893869307407	79.86932948915172	3209.719491127252	79.86299573067464	7814.184918858193	307024.2554756575	0.0	2014422.4150198416	876.3304808476806	82255.56875133213	0.1	0.599662400588322	1.5818073448733503	31524026.98330746	6226.723464459465	9316.118795561837	0	26265766.039873518
115	20	0	3226.187120068404	79.87059633130222	3229.889493290863	79.86426242223277	7882.887898393842	307080.8663695182	0.0	2014422.4150198416	876.3304808476806	83131.89923217981	0.1	0.5996594210163816	1.584596182492048	31910162.53136389	6274.623640883084	9387.81708147924	0	26587493.5267361
116	20	0	3246.512098924835	79.87186320337757	3250.186244124137	79.86552914371168	7951.603544293871	307137.4810632882	0.0	2014422.4150198416	876.3304808476806	84008.2297130275	0.1	0.599656457715704	1.5874103818842387	32298730.733468205	6322.523817306675	9459.516504614847	0	26911247.89685783
117	20	0	3266.9651251480614	79.87313010574616	3270.6105401155046	79.86679589547983	8020.331857408488	307194.0995572226	0.0	2199549.756126928	876.3304808476806	84884.56019387518	0.1	0.5996535103189737	1.5902494487783776	32689746.91534212	6370.423993730237	9531.2170649959	0	27237041.91960396
118	20	0	3287.547005436494	79.87439703828628	3291.163182758509	79.86806267729288	8089.072838587957	307250.72185157647	0.0	2199549.756126928	876.3304808476806	85760.89067472286	0.1	0.5996505784698306	1.5931129052767397	33083226.499258634	6418.324170153772	9602.91876264941	0	27564888.444786347
119	20	0	3308.2585515707437	79.87566400099874	3311.8449785832618	79.86932948915172	8157.826488682603	307307.3479466049	0.0	2199549.756126928	876.3304808476806	86637.22115557054	0.1	0.5996476618224734	1.5960002891715697	33479185.00465147	6466.224346577277	9674.621597602498	0	27894800.403171066
120	20	0	3329.1005804456395	79.87693099376177	3332.6567391880944	79.87059633130222	8226.592808542802	307363.97784256295	0.0	2388198.093141219	876.3304808476806	87513.55163641823	0.1	0.5996447600412684	1.5989111532951816	33877638.04872677	6514.124523000754	9746.32556988229	0	28226790.806988396
121	20	0	3350.073914102447	79.87819801669873	3353.5992812714017	79.87186320337757	8295.371799018993	307420.61153970583	0.0	2388198.093141219	876.3304808476806	88389.88211726591	0.1	0.5996418728003727	1.6018450649020268	34278601.34707829	6562.024699424203	9818.03067951568	0	28560872.75044451
122	20	0	3371.1793797612922	79.87946506981041	3374.673426663692	79.87313010574616	8364.163460961667	307477.24903828866	0.0	2388198.093141219	876.3304808476806	89266.21259811359	0.1	0.5996389997833913	1.6048016050808787	34682090.71430884	6609.924875847624	9889.73692652979	0	28897059.410239853
123	20	0	3392.417809853788	79.8807321529751	3395.8800023598387	79.87439703828628	8432.967795221375	307533.89033856656	0.0	2388198.093141219	876.3304808476806	90142.54307896127	0.1	0.5996361406830283	1.607780368195517	35088122.064652815	6657.825052271017	9961.444310951629	0	29235364.04608809
124	20	0	3413.790042055867	79.88199926631614	3417.2198405515323	79.87566400099874	8501.784802648726	307590.5354407948	0.0	2581645.4817505297	876.3304808476806	91018.87355980896	0.1	0.599633295200768	1.610780961352232	35496711.41260467	6705.72522869438	10033.152832808322	0	29575800.001239084
125	20	0	3435.296919320819	79.88326640983438	3438.6937786599365	79.87693099376177	8570.614484094383	307647.1843452285	0.0	2581645.4817505297	876.3304808476806	91895.20404065664	0.1	0.5996304630465588	1.613803003892719	35907874.8735498	6753.625405117716	10104.862492126878	0	29918380.703004774
126	20	0	3456.93928991254	79.88453358353055	3460.3026593685513	79.87819801669873	8639.45684040907	307703.83705212286	0.0	2581645.4817505297	876.3304808476806	92771.53452150432	0.1	0.5996276439385161	1.6168461269109229	36321628.66440052	6801.525581541023	10176.573288934305	0	30263119.663289163
127	20	0	3478.718007438989	79.88580078728295	3482.047330656279	79.87946506981041	8708.311872443563	307760.4935617332	0.0	2581645.4817505297	876.3304808476806	93647.865002352	0.1	0.5996248376026442	1.6199099727925304	36737989.1042365	6849.425757964302	10248.285223257844	0	30610030.479122464
128	20	0	3500.6339308858546	79.88706802121496	3503.928645830702	79.8807321529751	8777.1795810487	307817.15387431474	0.0	2780014.00570349	876.3304808476806	94524.19548319968	0.1	0.599622043772548	1.622994194775935	37156972.614946395	6897.3259343875525	10319.998295124387	0	30959126.83319456
129	20	0	3522.6879246504354	79.88833528544984	3525.9474635615697	79.88199926631614	8846.059967075373	307873.8179901227	0.0	2780014.00570349	876.3304808476806	95400.52596404737	0.1	0.5996192621891876	1.6260984565334027	37578595.721878	6945.226110810774	10391.712504561176	0	31310422.494397096
130	20	0	3544.880858575733	79.88960257962087	3548.1046479144866	79.88326640983438	8914.953031374533	307930.48590941244	0.0	2780014.00570349	876.3304808476806	96276.85644489505	0.1	0.5996164926006093	1.629222431771507	38002875.05448755	6993.126287233968	10463.427851595101	0	31663931.31836573
131	20	0	3567.21360798476	79.89086990397387	3570.4010683848314	79.88453358353055	8983.858774797187	307987.1576324392	0.0	2780014.00570349	876.3304808476806	97153.18692574273	0.1	0.5996137347617193	1.6323658038496642	38429827.346997686	7041.026463657133	10535.144336253288	0	32019667.24802664
132	20	0	3589.687053715064	79.89213725850968	3592.837599931866	79.88580078728295	9052.777198194399	308043.83315945836	0.0	2780014.00570349	876.3304808476806	98029.51740659041	0.1	0.5996109884340435	1.6355282654159342	38859469.43905624	7088.92664008027	10606.861958562746	0	32377644.314146012
133	20	0	3612.3020821534687	79.89340464335162	3615.4151230130783	79.88706802121496	9121.708302417292	308100.5124907252	0.0	2984710.3680599513	876.3304808476806	98905.8478874381	0.1	0.5996082533855132	1.6387095180591018	39291818.27640167	7136.826816503379	10678.580718550715	0	32737876.635884285
134	20	0	3635.0595852710353	79.89467205813291	3638.134523618728	79.88833528544984	9190.652088317043	308157.1956264951	0.0	2984710.3680599513	876.3304808476806	99782.17836828578	0.1	0.5996055293902387	1.6419092719762798	39726890.9115293	7184.7269929264585	10750.300616244087	0	33100378.421352606
135	20	0	3657.960460658243	79.89593950309943	3660.996693306618	79.88960257962087	9259.60855674489	308213.88256702345	0.0	2984710.3680599513	876.3304808476806	100658.50884913346	0.1	0.5996028162283177	1.6451272456551198	40164704.504366055	7232.62716934951	10822.021651669987	0	33465163.96817323
136	20	0	3681.0056115603898	79.89720697837447	3684.002529237078	79.89086990397387	9328.577708552124	308270.5733125656	0.0	2984710.3680599513	876.3304808476806	101534.83932998114	0.1	0.5996001136856336	1.6483631655699928	40605276.322946385	7280.527345772533	10893.74382485554	0	33832247.664042994
137	20	0	3704.1959469132203	79.89847448359124	3707.152934208171	79.89213725850968	9397.559544590094	308327.267863377	0.0	2984710.3680599513	876.3304808476806	102411.16981082883	0.1	0.5995974215536606	1.651616765891392	41048623.7440925	7328.427522195529	10965.46713582764	0	34201643.98730168
138	20	0	3727.5323813787736	79.89974201911824	3730.4488166911196	79.89340464335162	9466.55406571021	308383.96621971304	0.0	2984710.3680599513	876.3304808476806	103287.50029167651	0.1	0.5995947396292954	1.6548877882078377	41494764.25410189	7376.327698618496	11037.191584613523	0	34573367.507502586
139	20	0	3751.01583538146	79.90100958483364	3753.8910908659595	79.89467205813291	9535.561272763936	308440.66838182916	0.0	2984710.3680599513	876.3304808476806	104163.83077252419	0.1	0.5995920677146701	1.658175981259774	41943715.44943483	7424.227875041434	11108.917171240202	0	34947432.885986775
140	20	0	3774.647235144363	79.90227718061578	3777.480676657409	79.89593950309943	9604.581166602793	308497.37434998085	0.0	3198606.2550940337	876.3304808476806	105040.16125337187	0.1	0.599589405616991	1.6614811006847476	42395495.03740977	7472.128051464344	11180.6438957348	0	35323854.87646263
141	20	0	3798.4275127257724	79.90354480658797	3801.218499770972	79.89720697837447	9673.61374807836	308554.0841244235	0.0	3198606.2550940337	876.3304808476806	105916.49173421955	0.1	0.5995867531483728	1.6648029087733942	42850120.8369008	7520.0282278872255	11252.371758124325	0	35702648.32558603
142	20	0	3822.357606055945	79.90481246275102	3825.105491729261	79.89847448359124	9742.659018042272	308610.79770541267	0.0	3198606.2550940337	876.3304808476806	106792.82221506724	0.1	0.5995841101256881	1.6681411742356396	43307610.77904138	7567.928404310079	11324.100758435903	0	36083828.173547216
143	20	0	3846.438458974097	79.90608014910569	3849.1425899085566	79.89974201911824	9811.716977346223	308667.51509320387	0.0	3198606.2550940337	876.3304808476806	107669.15269591492	0.1	0.5995814763704157	1.671495671976679	43767982.90793109	7615.828580732904	11395.830896696658	0	36467409.45465963
144	20	0	3870.671021265634	79.90734786540779	3873.330737575583	79.90100958483364	9880.787626841962	308724.2362880526	0.0	3198606.2550940337	876.3304808476806	108545.4831767626	0.1	0.5995788517084905	1.6748661828822327	44231255.381346464	7663.728757155701	11467.562172933482	0	36853407.29795291
145	20	0	3895.0562486996073	79.90861561214822	3897.670883924532	79.90227718061578	9949.8709673813	308780.9612902144	0.0	3198606.2550940337	876.3304808476806	109421.81365761028	0.1	0.5995762359701786	1.6782524936125929	44697446.47145936	7711.628933578469	11539.294587173616	0	37241836.92776911
146	20	0	3919.5951030664146	79.90988338896022	3922.1639841143055	79.90354480658797	10018.966999816095	308837.6900999448	0.0	3198606.2550940337	876.3304808476806	110298.14413845797	0.1	0.599573628989934	1.6816543964051425	45166574.56555589	7759.529110001208	11611.028139444184	0	37632713.664364554
147	20	0	3944.288552215733	79.91115119584455	3946.8109993060007	79.90481246275102	10088.075724998274	308894.4227174995	0.0	3198606.2550940337	876.3304808476806	111174.47461930565	0.1	0.599571030606267	1.68507168888487	45638658.166761145	7807.42928642392	11682.76282977208	0	38026052.924512275
148	20	0	3969.137570094692	79.91241903304712	3971.6128967006266	79.90608014910569	10157.197143779815	308951.15914313396	0.0	3198606.2550940337	876.3304808476806	112050.80510015333	0.1	0.5995684406616331	1.6885041738824798	46113715.89477128	7855.329462846603	11754.498658184544	0	38421870.22211143
149	20	0	3994.1431367862883	79.91368690032367	3996.570649577056	79.90734786540779	10226.331257012753	309007.89937710384	0.0	3198606.2550940337	876.3304808476806	112927.13558100101	0.1	0.5995658590023007	1.6919516592598538	46591766.48658562	7903.229639269258	11826.235624708585	0	38820181.16879874
150	20	0	4019.3062385480416	79.9149547977975	4021.6852373302236	79.90861561214822	10295.478065549183	309064.64341966476	0.0	3198606.2550940337	876.3304808476806	113803.4660618487	0.1	0.599563285478245	1.6954139577424043	47072828.79724704	7951.129815691884	11897.973729371326	0	39221001.47456425
151	20	0	4044.6278678508943	79.91622272546942	4046.9576455095553	79.90988338896022	10364.637570241255	309121.3912710724	0.0	3198606.2550940337	876.3304808476806	114679.79654269638	0.1	0.599560719943031	1.6988908867580814	47556921.80058473	7999.0299921144815	11969.712972199777	0	39624346.948370464
152	20	0	4006.608365893096	79.91749068321778	4008.8526388935493	79.91115119584455	10433.809771941176	309178.14293158235	0.0	3198606.2550940337	876.3304808476806	115556.12702354406	0.1	0.599558162253711	1.6760873413039494	48036464.32980921	8046.930168537051	12041.453353221063	0	40023900.974836744
153	20	0	3968.946247253701	79.91875867116585	3971.1064177243866	79.91241903304712	10502.99467150121	309234.89840145037	0.0	3198606.2550940337	876.3304808476806	116432.45750439174	0.1	0.5995556122707186	1.65384978422085	48511499.15937573	8094.830344959592	12113.19487246219	0	40419699.19356661
154	20	0	3931.6381525295164	79.92002668931447	3933.7156037893515	79.91368690032367	10572.19226977368	309291.6576809321	0.0	3198606.2550940337	876.3304808476806	117308.78798523943	0.1	0.5995530698577748	1.6321554205605187	48982068.661660574	8142.730521382105	12184.937529950403	0	40811776.90915225
155	20	0	3894.680753895739	79.92129473778692	3896.6768506838907	79.9149547977975	10641.402567610967	309348.42077028326	0.0	3198606.2550940337	876.3304808476806	118185.11846608711	0.1	0.599550534881783	1.6109826903563231	49448214.81073882	8190.630697804589	12256.681325712707	0	41200169.0943213
156	20	0	3858.0707548091195	79.92256281621648	3859.9868435121116	79.91622272546942	10710.625565865505	309405.1876697596	0.0	3198606.2550940337	876.3304808476806	119061.44894693479	0.1	0.599548007212741	1.5903111859932662	49909979.18612921	8238.530874227044	12328.426259776112	0	41584910.393059164
157	20	0	3821.804889713914	79.923830924849	3823.6422985901177	79.91749068321778	10779.861265389789	309461.9583796169	0.0	3198606.2550940337	876.3304808476806	119937.7794277824	0.1	0.5995454867236542	1.5701215761238505	50367402.9765035	8286.431050649471	12400.172332167742	0	41966035.123697296
158	20	0	3785.879923750603	79.92509906368524	3787.639963152123	79.91875867116585	10849.10966703637	309518.7329001109	0.0	3198606.2550940337	876.3304808476806	120814.10990863015	0.1	0.5995429732904467	1.5503955355327108	50820526.98335992	8334.33122707187	12471.919542914722	0	42343577.28197487
159	20	0	3750.2926524673476	79.92636723284862	3751.9766150593323	79.92002668931447	10918.370771657856	309575.51123149734	0.0	3198606.2550940337	876.3304808476806	121690.44038947784	0.1	0.5995404667918801	1.5311156804143604	51269391.624663055	8382.231403494241	12543.667892044294	0	42717570.5440711
160	20	0	3715.0399015341545	79.92763543209477	3716.6490625115753	79.92129473778692	10987.644580106911	309632.2933740321	0.0	3198606.2550940337	876.3304808476806	122566.77087032552	0.1	0.5995379671094642	1.5122655085828616	51714036.938447334	8430.131579916584	12615.417379583349	0	43088048.269608706
161	20	100	3680.1185264597334	79.92890366142464	3681.6541437616393	79.92256281621648	11056.937805565029	309719.0813416695	366995.23423529655	3198606.2550940337	976.8771203642001	123543.64799068971	0.1	0.5995368807495459	1.5008650277187863	52154502.58639053	8517.931932761427	12746.952327562962	0	43455043.50463081
162	20	100	3645.525412311012	79.92061336616969	3647.424908526659	79.923830924849	11126.250449335539	309805.8751348006	363545.4783579818	3198606.2550940337	1076.4786212841952	124620.12661197392	0.1	0.5995641975789302	1.48972139146773	52590827.856540166	8605.73228560664	12878.473633370828	0	43818588.98376819
163	20	100	3611.257473435289	79.91232588416068	3613.5138225081173	79.92509906368524	11195.582512721865	309892.6747538165	360128.1501922258	3198606.2550940337	1175.1438679122023	125795.27047988612	0.1	0.5995912074920767	1.4787216033030535	53023051.66845438	8693.532638452225	13009.981301635853	0	44178717.13473215
164	20	100	3577.3116531849973	79.9040412139758	3579.9179294558617	79.92636723284862	11264.933997027514	309979.4801991082	356742.94491794077	3198606.2550940337	1272.881661040405	127068.15214092653	0.1	0.5996179196136755	1.4678613306912536	53451212.57584722	8781.33299129818	13141.475336985197	0	44535460.080414355
165	20	100	3543.6849236450585	79.89575935468378	3546.6343005813083	79.92763543209477	11334.304903556082	310066.29147106677	353389.5605795083	3198606.2550940337	1369.7007187334211	128437.85285965995	0.1	0.5996443427058632	1.4571364459182972	53875348.77002798	8869.133344144506	13272.955744044157	0	44888849.64175084
166	20	100	3510.374285362795	79.88748030510877	3513.660034302414	79.92890366142464	11403.695233611252	310153.10857008334	350067.69806011184	3198606.2550940337	1465.6096771060547	129903.462536766	0.1	0.5996704851860563	1.4465430139836817	54295498.08330778	8956.933696991202	13404.422527436283	0	45238917.34056123
167	20	100	3477.376767080385	79.87920406432036	3480.992255991023	79.92061336616969	11473.104988496796	310239.931496549	346777.06105463044	3198606.2550940337	1560.6170910936244	131464.07962785964	0.1	0.5996963551437363	1.4360772813418297	54711697.99237334	9044.73404983827	13535.875691783149	0	45585694.4023588
168	20	100	3444.6894254698295	79.87092910769887	3448.6281834885644	79.91232588416068	11542.534169516572	310326.76025085495	343517.356043651	3198606.2550940337	1654.7314352151727	133118.8110630748	0.1	0.5997219648901561	1.4257356815714983	55123985.62163047	9132.534402685706	13667.315239198273	0	45929211.75913812
169	20	100	3412.309344870413	79.86265543559293	3416.564993465706	79.9040412139758	11611.982777974525	310413.59483339236	340288.29226561973	3198606.2550940337	1747.9611043290413	134866.77216740383	0.1	0.599747321861051	1.4155147928133767	55532397.74651558	9220.334755533513	13798.741171794944	0	46269500.05213184
170	20	100	3380.233637028631	79.85438304773832	3384.7998888380957	79.89575935468378	11681.45081517469	310500.4352445524	337089.58169295045	3198606.2550940337	1840.3144143819043	136707.08658178573	0.1	0.5997724332106562	1.4054113453359858	55936970.79677638	9308.135108381692	13930.153491686564	0	46606589.63454618
171	20	100	3348.4594408405624	79.84611194423836	3353.3300985224164	79.88748030510877	11750.938282421188	310587.28148472635	333920.9390051258	3198606.2550940337	1931.799603150432	138638.88618493616	0.1	0.5997973058248959	1.3954222130409095	56337740.85972056	9395.93546123024	14061.552200986305	0	46940510.57426646
172	20	100	3316.983922096661	79.83784212507364	3322.1528771946905	79.87920406432036	11820.445181018227	310674.1335543055	330782.08156519686	3198606.2550940337	2022.4248309765132	140661.31101591268	0.1	0.599821946333851	1.3855444055299155	56734743.683434755	9483.735814079158	14192.937301807571	0	47271292.656539485
173	20	100	3285.8042732289523	79.82957359010206	3291.265505050845	79.87092910769887	11889.971512270104	310760.991453681	327672.7293906723	3198606.2550940337	2112.1981814945057	142773.5091974072	0.1	0.5998463611235251	1.375775060691	57128014.67997397	9571.536166928448	14324.308796263533	0	47598965.386631496
174	20	100	3254.9177130606004	79.82130633909948	3260.665287579408	79.86265543559293	11959.517277481202	310847.85518324433	324592.6051322775	3198606.2550940337	2201.1276623526637	144974.63685975986	0.1	0.5998705563476976	1.3661114377668007	57517588.928519465	9659.336519778108	14455.666686466895	0	47923557.9924587
175	20	100	3224.3214865578307	79.81304037196439	3230.3495553162056	79.85438304773832	12029.082477955992	310934.7247433868	321541.4340478134	3198606.2550940337	2289.2212059274075	147263.85806568727	0.1	0.5998945379377243	1.3565509108619347	57903501.17850893	9747.136872628138	14587.010974530247	0	48245099.427195095
176	20	100	3194.0128645841874	79.80477568822778	3200.315663611552	79.84611194423836	12098.667114999032	311021.6001344997	318518.94397727883	3198606.2550940337	2376.4866700307716	149640.34473571804	0.1	0.5999183116124864	1.3470909628641066	58285785.85273416	9834.937225478538	14718.341662565363	0	48563618.371854305
177	20	100	3163.989143657096	79.79651228766576	3170.5609923995903	79.83784212507364	12168.27118991497	311108.4813569745	315524.86531897914	3198606.2550940337	2462.931838611313	152103.27657432936	0.1	0.5999418828878254	1.3377291797463278	58664477.0504127	9922.737578329308	14849.65875268355	0	48879143.237848274
178	20	100	3134.2476457067196	79.78825017017712	3141.082945969787	79.82957359010206	12237.89470400854	311195.36841120257	312558.93100547954	3198606.2550940337	2548.5644224484313	154651.84099677778	0.1	0.5999652570854813	1.328463245222688	59039608.55023086	10010.537931180448	14980.962246996118	0	49191702.16952261
179	20	100	3104.7857178370764	79.77998933529308	3111.8789527405456	79.82130633909948	12307.537658584562	311282.2612975754	309620.876480144	3198606.2550940337	2633.3920598402515	157285.23305661805	0.1	0.5999884393415447	1.3192909357323883	59411213.81335381	10098.338284031957	15112.252147613559	0	49501323.04666519
180	20	100	3075.600732089408	79.77172978266752	3082.9464650349273	79.81304037196439	12377.200054947947	311369.1600164844	306710.43967280374	3198606.2550940337	2717.422317284855	160002.6553739029	0.1	0.6000114346144868	1.310210115728696	59779325.98641172	10186.138636883838	15243.528456645901	0	49808033.48699407
181	20	100	3046.690085207768	79.76347151232193	3054.282958858454	79.80477568822778	12446.88189440369	311456.0645683211	303827.3609767525	3198606.2550940337	2800.662690155198	162803.3180640581	0.1	0.6000342476927785	1.301218733251473	60143977.904457495	10273.938989736087	15374.791176203056	0	50111860.84862098
182	20	100	3018.051198406815	79.75521452378771	3025.8859336789787	79.79651228766576	12516.583178256877	311542.97495347704	300971.3832259425	3198606.2550940337	2883.120603367785	165686.4386674259	0.1	0.6000568832021042	1.2923148157635835	60505202.09389342	10361.739342588708	15506.040308394236	0	50412832.23249087
183	20	100	2989.6815171417907	79.74695881708651	2997.7529122085975	79.78825017017712	12586.303907812677	311629.8911723438	298142.2516713318	3198606.2550940337	2964.8034120448615	168651.24207947074	0.1	0.6000793456122286	1.28349646623297	60863030.775374286	10449.539695441697	15637.275855328422	0	50710974.48479965
184	20	100	2961.578510880658	79.73870439150475	2969.881440187592	79.77998933529308	12656.044084376352	311716.8132253129	295339.71395852225	3198606.2550940337	3045.7184021704843	171696.96048164123	0.1	0.6001016392435042	1.2747618594437278	61217495.86667996	10537.340048295058	15768.497819113894	0	51006314.199389555
185	20	100	2979.347981945942	79.73045124706424	2988.009994636989	79.77172978266752	12725.803709253249	311803.741112776	297111.7516917847	3198606.2550940337	3127.118882086042	174824.07936372727	0.1	0.6001237682730701	1.2856783518911605	61574087.74796121	10625.140401148788	15899.706201858702	0	51303425.95171679
186	20	100	2997.2240698376177	79.72219938341905	3006.2491921264623	79.76347151232193	12795.582783748801	311890.67483512464	298894.42164828157	3198606.2550940337	3209.0077647294065	178033.08712845668	0.1	0.6001457367407319	1.2965979612629812	61932819.17995419	10712.940754002888	16030.901005670312	0	51602320.37400428

187	20	100	3015.2074142566435	79.71394880046861	3024.5997078412443	79.75521452378771	12865.381309168533	311977.61439275055	300687.7876215811	3198606.2550940337	3291.3879805161414	181324.4751089728	0.1	0.6001675485545649	1.307520663266923	62293702.999959834	10800.741106857358	16162.082232655957	0	51903008.16226816
188	20	100	3033.2986587421833	79.7056994976221	3043.06222108622	79.74695881708651	12935.199286818053	312064.5597860454	302491.9137869553	3198606.2550940337	3374.262477444074	184698.7375864169	0.1	0.6001892074962336	1.3184464337966	62656752.122302845	10888.541459712196	16293.249884922174	0	52205500.0767016
189	20	100	3051.4984506946366	79.69745147477897	3061.6374153110623	79.73870439150475	13005.036718003059	312151.5110154009	304306.8647061369	3198606.2550940337	3457.6342211991805	188156.37180761606	0.1	0.6002107172260683	1.3293752489304074	63021979.53879389	10976.341812567405	16424.403964575264	0	52509806.94205843
190	20	100	3069.8074413988043	79.6892047318387	3080.325978135517	79.73045124706424	13074.893604029336	312238.46808120876	306132.70532788185	3198606.2550940337	3541.5061952616134	191697.87800287767	0.1	0.6002320812878897	1.340307084930393	63389398.31919413	11064.142165422983	16555.544473721064	0	52815939.64804018
191	20	100	3088.226286047197	79.68095926833321	3099.1286013748418	79.72219938341905	13144.769946202758	312325.4309838608	307969.5009895613	3198606.2550940337	3625.8814010121782	195323.75940388985	0.1	0.6002533031136064	1.3512419182411177	63759021.61168366	11151.942518278931	16686.67141446483	0	53123909.14968755
192	20	100	3106.7556437634803	79.67271508416215	3118.045981065402	79.71394880046861	13214.665745829283	312412.39972374873	309817.31742200616	3198606.2550940337	3710.7628578401254	199034.52226173	0.1	0.6002743860276039	1.3621797254885635	64130862.64333199	11239.74287113525	16817.784788911697	0	53433726.46777133
193	20	100	3125.396177626061	79.664472178735	3137.07881749042	79.7056994976221	13284.581004214962	312499.3743012644	311676.2207497132	3198606.2550940337	3796.1536032510053	202830.675864981	0.1	0.6002953332509141	1.3731204834790196	64504934.72056996	11327.543223991936	16948.88459916599	0	53745402.68918682
194	20	100	3144.1485546918175	79.65623055219656	3156.2278152058907	79.69745147477897	13354.51572266593	312586.3547167997	313546.27749392414	3198606.2550940337	3882.0566929753686	206712.73255795636	0.1	0.6003161479052086	1.384064169197967	64881251.22966773	11415.343576848993	17079.970847331802	0	54058948.9673502
195	20	100	3163.0134460199683	79.64799020395644	3175.493683066641	79.6892047318387	13424.46990248841	312673.3409707464	315427.55457500566	3198606.2550940337	3968.4752010781094	210681.20775903447	0.1	0.6003368330165976	1.395010759808979	65259825.63721306	11503.143929706419	17211.043535512756	0	54374376.52259911
196	20	100	3181.9915266960884	79.63975113391453	3194.877134252557	79.68095926833321	13494.443544988715	312760.3330634965	317320.1193152161	3198606.2550940337	4055.4122200685797	214736.61997910304	0.1	0.6003573915192578	1.4059602326526317	65640671.49059286	11590.944282564215	17342.10266581201	0	54691696.64259235
197	20	100	3201.083475856265	79.63151334184816	3214.378886294972	79.67271508416215	13564.436651473241	312847.3309954419	319224.0394407518	3198606.2550940337	4142.870861011251	218879.49084011427	0.1	0.600377826258903	1.4169125652454049	66023802.41847874	11678.74463542238	17473.14824033249	0	55010920.68271492
198	20	100	3220.2899767114027	79.62327682753475	3233.9996611032116	79.664472178735	13634.449223248477	312934.33476697444	321139.38308341824	3198606.2550940337	4230.854253636845	223110.34509375112	0.1	0.6003981399960842	1.4278677352785873	66409232.13131395	11766.544988280913	17604.18026117643	0	55332060.066483594
199	20	100	3239.611716571671	79.61504159038414	3253.7401849913017	79.65623055219656	13704.481261620997	313021.3443784862	323066.21878418117	3198606.2550940337	4319.365546454429	227429.71064020557	0.1	0.6004183354093582	1.43882572061719	66796974.421804756	11854.345341139817	17735.1987304457	0	55655126.28595765
200	20	100	3259.049386871101	79.60680763041894	3273.6011887048417	79.64799020395644	13774.53276789746	313108.3598303692	325004.6154956304	3198606.2550940337	4408.40790686419	231838.11854706975	0.1	0.6004384150983068	1.4497864992988778	67187043.1654133	11942.14569399909	17866.203650241718	0	55980130.902147435
201	20	100	3278.6036831923275	79.59857494729422	3293.583407448036	79.63975113391453	13844.603743384621	313195.3811230153	326954.6425840759	3198606.2550940337	4497.984521270787	236336.10306834054	0.1	0.6004583815864286	1.460750049532888	67579452.32085449	12029.946046858731	17997.195022665546	0	56307085.54542961
202	20	100	3298.2753052914813	79.5903435407876	3313.6875809108997	79.63151334184816	13914.694189389314	313282.40825681674	328916.3698316447	3198606.2550940337	4588.098595197264	240924.2016635378	0.1	0.6004782373239007	1.4717163496989538	67974215.93059546	12117.746399718742	18128.172849817784	0	56636001.91596295
203	20	100	3318.06495712323	79.58211341055423	3333.9144532966206	79.62327682753475	13984.804107218466	313369.4412321655	330889.8674387662	3198606.2550940337	4678.753353399666	245602.95501693746	0.1	0.6004979846902221	1.482685378346226	68371348.12135859	12205.546752579123	18259.137133798562	0	56966891.78410781
204	20	100	3337.9733468659697	79.57388455649446	3354.264773349092	79.61504159038414	14054.933498179087	313456.4800494537	332875.20602784306	3198606.2550940337	4769.952039982637	250372.90705692008	0.1	0.6005176259967437	1.493657114192226	68770863.10462618	12293.347105439872	18390.08787670755	0	57299766.99084581
205	20	0	3358.0011869471655	79.565656978141	3374.7392943806162	79.60680763041894	14125.075651249514	313513.5226953748	0.0	3198606.2550940337	4769.952039982637	255142.8590969027	0.1	0.6005394275932794	1.4997911272277595	69172775.17714939	12341.247281870325	18461.512431263225	0	57634639.448205076
206	20	0	3378.1491940688484	79.56692414949474	3394.933662115116	79.59857494729422	14195.230567286379	313570.56917018583	0.0	3198606.2550940337	4769.952039982637	259912.81113688534	0.1	0.6005326413898318	1.5058185224490526	69577098.7222079	12389.14745830075	18532.938123306027	0	57971521.14040467
207	20	0	3398.4180892332615	79.56818983986328	3415.248936937775	79.5903435407876	14265.398247146375	313627.61947414384	0.0	3198606.2550940337	4769.952039982637	264682.763176868	0.1	0.6005258971313479	1.5118463472619363	69983848.20863658	12437.047634731145	18604.36495150649	0	58310424.122854
208	20	0	3418.808597768661	79.56945405017905	3435.68584310558	79.58211341055423	14335.578691686253	313684.6736075058	0.0	3198606.2550940337	4769.952039982637	269452.7152168506	0.1	0.6005191943699172	1.517874593694534	70393038.19208492	12484.947811161514	18675.792914535967	0	58651360.52329474
209	20	0	3439.3214493552728	79.57071678027164	3456.2451092160363	79.57388455649446	14405.771901762819	313741.73157052876	0.0	3198606.2550940337	4769.952039982637	274222.6672568333	0.1	0.600512532664435	1.5239032538500616	70804683.31553513	12532.847987591853	18747.22201106581	0	58994342.54223564
210	20	0	3459.9573780514042	79.5719780308283	3476.9274682331966	79.565656978141	14475.977878232938	313798.79336346977	0.0	3198606.2550940337	4769.952039982637	278992.61929681594	0.1	0.6005059115804795	1.5299323199062786	71218798.30982773	12580.748164022163	18818.652239767835	0	59339382.453387946
211	20	0	3480.717122319713	79.57323780216872	3497.7336575138384	79.56692414949474	14546.196621953532	313855.8589865859	0.0	3198606.2550940337	4769.952039982637	283762.5713367986	0.1	0.6004993306901819	1.5359617841149622	71635397.99418795	12628.648340452446	18890.083599314094	0	59686492.604104966
212	20	0	3501.6014250536314	79.57449760450194	3518.664352065031	79.56818983986328	14616.428133781581	313912.92844013433	0.0	3198606.2550940337	4769.952039982637	288532.52337678126	0.1	0.6004927850369876	1.5419916212970075	72054497.27675726	12676.5485168827	18961.516089732642	0	60035685.41582554
213	20	0	3522.6110336039533	79.57575743787127	3539.7202969402383	79.56945405017905	14686.672414574123	313970.0017243721	0.0	3198606.2550940337	4769.952039982637	293302.4754167639	0.1	0.6004862742246633	1.5480218237193306	72476111.15512547	12724.448693312926	19032.949711051187	0	60386973.38451571
214	20	0	3543.746699805577	79.57701730170749	3560.902241651506	79.57071678027164	14756.929465188252	314027.0788395563	0.0	3198606.2550940337	4769.952039982637	298072.4274567466	0.1	0.6004797978629088	1.5540523837213873	72900254.71686792	12772.348869743124	19104.384463297203	0	60740369.081118375
215	20	0	3565.0091800044106	79.5782771961765	3582.2109401961575	79.5719780308283	14827.19928648112	314084.15978594415	0.0	3198606.2550940337	4769.952039982637	302842.37949672923	0.1	0.6004733555672477	1.5600832937146543	73326943.14008535	12820.249046173294	19175.82034649793	0	61095885.15200065
216	20	0	3586.399235084437	79.57953712058665	3603.647151083623	79.57323780216872	14897.481879309938	314141.2445637928	0.0	3198606.2550940337	4769.952039982637	307612.3315367119	0.1	0.6004669469589187	1.566114546182106	73756191.69394743	12868.149222603435	19247.257360680494	0	61453534.31940975
217	20	0	3607.9176304949438	79.58079707498155	3625.2116373624563	79.57449760450194	14967.777244531975	314198.3331733594	0.0	3198606.2550940337	4769.952039982637	312382.28357669455	0.1	0.600460571664771	1.5721461336777045	74188015.73923878	12916.049399033549	19318.695505871787	0	61813329.38192535
218	20	0	3629.5651362779136	79.58205705923963	3646.905166636477	79.57575743787127	15038.085383004553	314255.4256149012	0.0	3198606.2550940337	4769.952039982637	317152.2356166772	0.1	0.6004542293164362	1.5781780488230353	74622430.72890833	12963.949575463634	19390.134782098583	0	62175283.214918606
219	20	0	3651.342527095581	79.58331707348434	3668.728511102859	79.57701730170749	15108.406295585055	314312.52188867534	0.0	3198606.2550940337	4769.952039982637	321922.18765665987	0.1	0.6004479195509561	1.584210284309611	75059452.20862311	13011.849751893691	19461.575189387775	0	62539408.77101289
220	20	0	3673.2505822581543	79.58457711771658	3690.682447579613	79.5782771961765	15178.739983130923	314369.6219949391	0.0	3198606.2550940337	4769.952039982637	326692.1396966425	0.1	0.6004416420106814	1.5902428328983678	75499095.81732416	13059.74992832372	19533.016727766255	0	62905719.08054732
221	20	0	3695.2900857517034	79.58583719181468	3712.767757533234	79.57953712058665	15249.086446499654	314426.72593394975	0.0	3198606.2550940337	4769.952039982637	331462.0917366252	0.1	0.6004353963431752	1.5962756874191568	75941377.28778619	13107.65010475372	19604.459397260915	0	63274227.25204348
222	20	0	3717.4618262662134	79.58709729590196	3734.9852271065247	79.58079707498155	15319.445686548803	314483.8337059645	0.0	3198606.2550940337	4769.952039982637	336232.04377660784	0.1	0.6004291822011174	1.602308840770249	76386312.44718008	13155.550281183692	19675.90319789853	0	63644946.47267322
223	20	0	3739.7665972238105	79.5883574297342	3757.3356471465695	79.58205705923963	15389.817704135981	314540.9453112407	0.0	3198606.2550940337	4769.952039982637	341001.9958165905	0.1	0.6004229992422129	1.6083422859178287	76833917.21763976	13203.450457613637	19747.348129705875	0	64017890.0087323
224	20	0	3762.2051968071532	79.58961759367979	3779.8198132328953	79.58331707348434	15460.202500118861	314598.06075003557	0.0	3198606.2550940337	4769.952039982637	345771.94785657316	0.1	0.6004168471291046	1.6143760158954905	77284207.61683287	13251.350634043552	19818.79419270996	0	64393071.206113786
225	20	0	3784.778427987996	79.59087778737197	3802.438525705776	79.58457711771658	15530.60007535517	314655.18002260645	0.0	3198606.2550940337	4769.952039982637	350541.8998965558	0.1	0.6004107255292793	1.6204100238037558	77737199.75853255	13299.250810473439	19890.241386937676	0	64770503.49078702
226	20	0	3807.487098555924	79.5921380110565	3825.192589694736	79.58583719181468	15601.010430702694	314712.3031292107	0.0	3198606.2550940337	4769.952039982637	355311.8519365385	0.1	0.6004046341149823	1.6264443028095807	78192909.85319419	13347.150986903298	19961.6897124158	0	65150200.36927583
227	20	0	3830.3320211472596	79.59339826473428	3848.082815147195	79.58709729590196	15671.433567019276	314769.4300701057	0.0	3198606.2550940337	4769.952039982637	360081.8039765211	0.1	0.6003985725631334	1.6324788461458626	78651354.2085359	13395.051163333128	20033.139169171103	0	65532175.429143175
228	20	0	3853.3140132741432	79.59465854828353	3871.110016857306	79.5883574297342	15741.869485162815	314826.56084554875	0.0	3198606.2550940337	4769.952039982637	364851.7560165038	0.1	0.6003925405552465	1.6385136471109465	79112549.23012297	13442.95133976293	20104.5897572306	0	65916442.33947873
229	20	0	3826.726146582552	79.59591886170506	3844.3384859790694	79.58961759367979	15812.318185991271	314883.6954557973	0.0	3198606.2550940337	4769.952039982637	369621.70805648644	0.1	0.6003865377773427	1.6235819343583242	79570562.00617328	13490.851516192704	20176.04147662106	0	66298057.8082411
230	20	0	3800.321736171132	79.5971792051222	3817.7520991578267	79.59087778737197	15882.779670362659	314940.8339011087	0.0	3198606.2550940337	4769.952039982637	374391.6600964691	0.1	0.6003805639198758	1.6088829670286873	80025414.49418038	13538.75169262245	20247.49432736938	0	66677040.13037624
231	20	0	3774.099516191551	79.59843957853573	3791.3495759948723	79.5921380110565	15953.253939135053	314997.9761817404	0.0	3198606.2550940337	4769.952039982637	379161.61213645176	0.1	0.6003746186776528	1.5944109176725587	80477128.5001315	13586.651869052168	20318.948309502564	0	67053407.47459546
232	20	0	3748.0582295298295	79.59969998182393	3765.1296449463193	79.59339826473428	16023.740993166584	315055.12229794986	0.0	3198606.2550940337	4769.952039982637	383931.5641764344	0.1	0.6003687017497541	1.580160157066883	80925725.67955129	13634.552045481858	20390.403423047275	0	67427177.88424504
233	20	0	3722.196627746074	79.60096041498761	3739.0910432618557	79.59465854828353	16094.24083331544	315112.2722499945	0.0	3198606.2550940337	4769.952039982637	388701.5162164171	0.1	0.6003628128394651	1.56612524583763	81371227.53854258	13682.452221911519	20461.85966803052	0	67798369.27817352
234	20	0	3696.513471014626	79.60222087815009	3713.2325169239407	79.59591886170506	16164.753460439868	315169.4260381318	0.0	3198606.2550940337	4769.952039982637	393471.46825639973	0.1	0.600356951654198	1.5523009265036534	81813655.43481523	13730.352398341152	20533.317044479074	0	68166999.45158808
235	20	0	3671.0075280646247	79.60348137131214	3687.552820587405	79.5971792051222	16235.278875398171	315226.5836626193	0.0	3198606.2550940337	4769.952039982637	398241.4202963824	0.1	0.6003511179054246	1.5386821159172182	82253030.57871175	13778.252574770757	20604.775552419946	0	68533086.07690983
236	20	0	3645.6775761209788	79.60474189435205	3662.0507175194784	79.59843957853573	16305.817079048711	315283.74512371444	0.0	3198606.2550940337	4769.952039982637	403011.37233636505	0.1	0.6003453113086012	1.5252638980783857	82689374.03422242	13826.152751200332	20676.23519187991	0	68896646.70461972
237	20	0	3620.522400845744	79.60600244727061	3636.7249795402254	79.59969998182393	16376.368072249908	315340.9104216748	0.0	3198606.2550940337	4769.952039982637	407781.3243763477	0.1	0.6003395315831038	1.5120415173018045	83122706.71999647	13874.05292762988	20747.69596288586	0	69257698.76410086
238	20	0	3595.540796279908	79.6072630301912	3611.574386963401	79.60096041498761	16446.93185586024	315398.0795567579	0.0	3198606.2550940337	4769.952039982637	412551.27641633037	0.1	0.6003337784521586	1.4990103717159486	83553049.41034397	13921.9531040594	20819.15786546457	0	69616259.56447275
239	20	100	3570.7315647855767	79.60852364299204	3586.597728537714	79.60222087815009	16517.515143067	315485.2545429199	356086.73019036895	3198606.2550940337	4867.510048253971	417418.78646458435	0.1	0.6003266509149299	1.4904055158492495	83980422.73623314	14009.753456918595	20950.16560906195	0	69972346.29542322
240	20	100	3546.093516988556	79.6002831396017	3562.218939218759	79.60348137131214	16588.117935179343	315572.43538055365	353629.7310974116	3198606.2550940337	4964.394906088878	422383.18137067324	0.1	0.600348047233187	1.4819877650936755	84404847.18549256	14097.553809778161	21081.15979241836	0	70325976.0272753
241	20	100	3521.625471721335	79.59204542682195	3538.0057710559636	79.60474189435205	16658.740233506498	315659.6220700518	351189.68530290184	3198606.2550940337	5060.61125822666	427443.7926288999	0.1	0.600369326549776	1.4736481049536905	84826343.10537615	14185.354162638096	21212.140420125797	0	70677165.71332756
242	20	100	3497.3262559664577	79.58381050348532	3513.957099479462	79.60600244727061	16729.382039357788	315746.8146118072	348766.47582906	3198606.2550940337	5156.163717357909	432599.9563462578	0.1	0.6003904909621683	1.4653849927025053	85244930.70274156	14273.154515498401	21343.107496774406	0	71025932.18990086
243	20	100	3473.194704800289	79.57557836842479	3490.071807551006	79.6072630301912	16800.04335404262	315834.0130062126	346359.9865052518	3198606.2550940337	5251.05686434565	437851.0132106035	0.1	0.6004115425163795	1.4571969330934873	85660630.04501882	14360.954868359075	21474.061026952462	0	71372292.17714539
244	20	100	3449.229661337167	79.56734902084139	3466.348785912197	79.60852364299204	16870.724178870496	315921.21725366096	343970.10196241864	3198606.2550940337	5345.295248444942	443196.30845904845	0.1	0.6004324832085386	1.4490824765210695	86073461.06117283	14448.755221220119	21605.001015246497	0	71716262.27984147
245	20	100	3425.4299766739405	79.55912245920142	3442.7869327330855	79.6002831396017	16941.424515150997	316008.4273545451	341596.7076275473	3198606.2550940337	5438.883387520982	448635.1918465694	0.1	0.6004533149863993	1.4410402172663532	86483443.54265839	14536.55557408153	21735.927466241177	0	72057858.98819762
246	20	100	3401.79450983489	79.55089717185551	3419.3852186080608	79.59204542682195	17012.144364193795	316095.6433092579	339239.68971811025	3198606.2550940337	5531.8257682656695	454167.01761483506	0.1	0.6004740442802164	1.4330688080695488	86890597.14436959	14624.35592694331	21866.840382033144	0	72397098.67863895
247	20	100	3378.322127717029	79.54267315866234	3396.1425552611513	79.58381050348532	17082.88372730865	316182.8651181924	336898.9352360059	3198606.2550940337	5624.1268464125205	459791.1444612476	0.1	0.600494672916655	1.425166925669855	87294941.38558179	14712.15627980546	21997.739764718805	0	72733997.61459361
248	20	100	3355.0117050357817	79.53445041935794	3373.05786181139	79.57557836842479	17153.642605805413	316270.0927817414	334574.331964797	3198606.2550940337	5715.7910469508215	465506.93550819845	0.1	0.6005152026788756	1.417333285903398	87696495.65088622	14799.956632667978	22128.625616394565	0	73068571.94727178
249	20	100	3331.8621242710346	79.52622895416829	3350.130064722573	79.56734902084139	17224.42100099402	316357.326300298	332265.76846036693	3198606.2550940337	5806.822764337224	471313.7582725357	0.1	0.6005356353078234	1.4095666422447333	88095279.19112164	14887.756985530867	22259.49793915695	0	73400837.71644068
250	20	100	3308.8722756135644	79.51800876295172	3327.358097753345	79.55912245920142	17295.2189141845	316444.56567425514	329973.1340483527	3198606.2550940337	5897.226362706635	477210.9846352423	0.1	0.600555972503465	1.401865784413081	88491311.12429526	14975.557338394123	22390.35673510225	0	73730810.85119277
251	20	100	3286.0410569118308	79.50978984581128	3304.740901907649	79.55089717185551	17366.03634668696	316531.8109040059	327696.31881804427	3565601.48932933	5987.0061760814415	483197.99081132375	0.1	0.6005762159259921	1.394229537039907	88884610.4365005	15063.357691257746	22521.202006326872	0	74058507.17070982
252	20	100	3263.367373619139	79.50157220252515	3282.2774253953994	79.54267315866234	17436.8732998116	316619.06198994326	325435.2136169402	3929146.967687312	6076.166508579234	489274.15731990297	0.1	0.6005963671976935	1.3866567583972413	89275195.9828263	15151.158044121741	22652.03375492664	0	74383942.38502069
253	20	100	3240.850138741167	79.49335583250392	3259.9666235734	79.53445041935794	17507.72977486871	316706.3189324604	323189.710046073	4289275.117879538	6164.711634619253	495438.86895452224	0.1	0.6006164279033495	1.3791463391762204	89663086.48826149	15238.958396986103	22782.851982997032	0	74707132.09575605
254	20	100	3218.488272783853	79.4851407357709	3237.807458896793	79.52622895416829	17578.605773168667	316793.5817319504	320959.7004544228	4646018.062797478	6252.645799127315	501691.51475364954	0.1	0.6006363995913098	1.3716972013207096	90048300.54859242	15326.758749850836	22913.656692633172	0	75028091.79689443
255	20	100	3196.2807037016446	79.4769269121045	3215.79890087082	79.51800876295172	17649.501296021936	316880.8503888064	318745.07793263404	4999407.623376987	6339.973217738995	508031.4879713885	0.1	0.6006562837745315	1.3643082969108011	90430856.63129492	15414.559102715937	23044.447885929607	0	75346836.87550612
256	20	100	3174.2263668461032	79.46871436103805	3193.9399260029336	79.50978984581128	17720.416344739067	316968.1249034215	316545.73631015816	5349475.321437099	6426.698077002052	514458.1860483906	0.1	0.6006760819315877	1.3569786070937697	90810773.07641919	15502.359455581405	23175.22556498053	0	75663382.61249122
257	20	100	3152.3242049148653	79.46050308235016	3172.229517755211	79.50157220252515	17791.3509206307	317055.405276189	314361.5701497556	5696252.382491729	6512.8245345773275	520971.0105829679	0.1	0.600695795507637	1.3497071410601058	91188068.09746794	15590.159808447243	23305.989731879672	0	75977744.18331037
258	20	100	3130.5731679009527	79.4522930758194	3150.6666664971167	79.49335583250392	17862.305025007565	317142.69150750205	312192.4747391185	6039769.73853538	6598.35671943736	527569.3673024053	0.1	0.6007154259153624	1.3424929350623955	91562759.7822722	15677.96016131345	23436.740388720296	0	76289936.65871488
259	20	100	3108.972213042436	79.44408434134697	3129.2503694585657	79.4851407357709	17933.278659180476	317229.9835977539	310038.3460913982	6380058.030801	6683.29873206514	534252.6660344704	0.1	0.6007349745358812	1.3353350514750826	91934866.09385619	15765.760514180023	23567.477537595434	0	76599975.0054666
260	20	100	3087.520304772443	79.43587687834398	3107.9796306833123	79.4769269121045	18004.27182446034	317317.2815473379	307899.08093505865	6717147.612493951	6767.654644650087	541020.3206791205	0.1	0.6007544427196156	1.3282325778930055	92304404.87129885	15853.560867046966	23698.2011805973	0	76907874.08705732
261	20	100	3066.216414669513	79.42767068695686	3086.8534609826565	79.46871436103805	18075.284522158145	317404.5853566472	305774.57671223173	7051068.551499076	6851.428501283575	547871.749180404	0.1	0.6007738317871492	1.3211846262669535	92671393.8305906	15941.361219914279	23828.911319818115	0	77213648.66442063
262	20	100	3045.059521408293	79.41946576647426	3065.8708778894647	79.46050308235016	18146.316753584975	317491.89502607525	303664.7315726938	7381850.633064273	6934.624318152808	554806.3734985568	0.1	0.600793143030039	1.3141903320744526	93035850.56548038	16029.161572781959	23959.60795734939	0	77517313.39663985
263	20	100	3024.0486107105758	79.41126211692011	3045.030905612504	79.4522930758194	18217.368520051998	317579.2105560154	301569.44436862844	7709523.362454945	7017.246083733253	561823.6195822901	0.1	0.6008123777116131	1.3072488535240956	93397792.54832062	16116.961925650006	24090.2910952823	0	77818882.84165016
264	20	100	3003.1826752966726	79.40305973782839	3024.3325749910746	79.44408434134697	18288.439822870467	317666.5319468609	299488.61464978976	8034115.967587222	7099.297758979771	568922.9173412698	0.1	0.6008315370677348	1.300359370791872	93757237.13090451	16204.762278518423	24220.960735707427	0	78118371.45693754
265	20	100	2982.4607148371256	79.39485862910055	3003.774923449974	79.43587687834398	18359.53066335173	317753.8591990053	297422.142660096	8355657.401635036	7180.783277516784	576103.7006187866	0.1	0.6008506223075485	1.2935210852880181	94114201.54529782	16292.562631387209	24351.616880715126	0	78415793.60023083
266	20	100	2961.8817359047493	79.38665879063824	2983.356994954746	79.42767068695686	18430.641042807212	317841.19231284194	295369.9293307297	8674176.345612315	7261.706545826573	583365.4071646133	0.1	0.6008696346141957	1.28673321895293	94468702.90466541	16380.362984256362	24482.259532395285	0	78711163.53019041
267	20	100	2941.4447519270066	79.37846022185296	2963.077839967239	79.41946576647426	18501.770962548442	317928.5312887643	293331.8762774913	8989701.210931294	7342.071443436845	590707.4786080502	0.1	0.6008885751455102	1.2799950135808578	94820758.2040906	16468.163337125883	24612.888692837325	0	79004495.40709211
268	20	100	2921.1487831387103	79.37026292252389	2942.9365154014763	79.41126211692011	18572.920423887022	318015.8761271659	291307.88579399366	9302260.141936773	7421.8818231064315	598129.3604311566	0.1	0.6009074450346913	1.2733057301700652	95170384.32139091	16555.963689995773	24743.504364130204	0	79295803.29350607
269	20	100	2900.9928565350533	79.36206689255278	2922.932084579813	79.40305973782839	18644.089428134652	318103.2268284402	289297.86084871273	9611881.018416917	7501.14151101019	605630.5019421668	0.1	0.6009262453909582	1.26666464829829	95517598.0179273	16643.76404286603	24874.106548362644	0	79585101.15497056
270	20	100	2880.9760058249612	79.35387213159636	2903.063617189397	79.39485862910055	18715.277976603116	318190.58339298074	287301.70507929986	9918591.45808972	7579.854306922326	613210.3562490891	0.1	0.6009449773001747	1.2600710655223482	95862415.93940628	16731.564395736656	25004.695247622556	0	79872402.86066079
271	20	100	2861.097271384769	79.345678639434	2883.3301892389245	79.38665879063824	18786.486070604285	318277.9458211811	285319.3227879732	10222418.819066472	7658.023984398484	620868.3802334876	0.1	0.6009636418254676	1.2535242968007931	96204854.61668026	16819.36474860765	25135.27046399773	0	80157722.18405594
272	20	100	2841.3557002122143	79.33748641572262	2863.730883015689	79.37846022185296	18857.71371145012	318365.31411343487	283350.618938274	10523390.202292414	7735.654290956914	628604.0345244445	0.1	0.6009822400078144	1.247023673938641	96544930.46653783	16907.165101479015	25265.83219957538	0	80441072.80359733
273	20	100	2821.75034588075	79.32929546011913	2844.264787042926	79.37026292252389	18928.96090045267	318452.6882701356	281395.49914915283	10821532.453963745	7812.748948258052	636416.7834727025	0.1	0.6010007728666197	1.2405685450531403	96882659.79249167	16994.965454350746	25396.380456442363	0	80722468.30334526
274	20	100	2802.280268494173	79.32110577264805	2824.930996037445	79.36206689255278	19000.22763892407	318540.06829167705	279453.869690128	11116872.167922268	7889.311652282744	644306.0951249852	0.1	0.6010192414002709	1.23415827405967	97218058.78556089	17082.765807222844	25526.915236685192	0	81001922.1736299
275	20	100	2782.944534641563	79.31291735284394	2805.728610867541	79.35387213159636	19071.513928176544	318627.4541784528	277525.6374777931	11413983.919614052	7965.346073509537	652271.4411984948	0.1	0.6010376465866737	1.227792240176955	97551143.52504584	17170.56616009531	25657.43654238968	0	81279447.81169794
276	20	100	2763.7422173525365	79.30473020036388	2786.6567385112066	79.345678639434	19142.819769522408	318714.84593085654	275610.71007134364	11712878.341262333	8040.855857090727	660312.2970555854	0.1	0.6010559893837791	1.2214698374505997	97881929.97930007	17258.366512968143	25787.94437564141	0	81555058.52235569
277	20	100	2744.672396052804	79.2965443153552	2767.714492014619	79.33748641572262	19214.14516427406	318802.243549282	273708.99566749024	12013566.128883915	8115.8446230270265	668428.1416786124	0.1	0.6010742707300889	1.2151904742943853	98210434.00649571	17346.166865841344	25918.438738525612	0	81828767.51860543
278	20	100	2725.7341565200395	79.28835969710745	2748.9009904509126	79.32929546011913	19285.490113743992	318889.647034123	271820.40309670824	12316058.04267087	8190.3159663411925	676618.4576449536	0.1	0.6010924915451448	1.2089535730483456	98536671.35538293	17433.96721871491	26048.919633126934	0	82100587.9222803
279	20	100	2706.926590840051	79.28017634552299	2730.215358879225	79.32110577264805	19356.85461924478	318977.05638577323	269944.8418185382	12620364.907377006	8264.273457250381	684882.731102204	0.1	0.6011106527300064	1.2027585695530354	98860657.66604544	17521.767571588847	26179.387061529676	0	82370532.76467231
280	20	100	2688.2487973632547	79.27199426025912	2711.65672830403	79.31291735284394	19428.238682089086	319064.4716046265	268082.2219159838	12926497.612704888	8337.720641336953	693220.4517435409	0.1	0.6011287551677118	1.196604912739252	99182408.470651	17609.567924463154	26309.841025817557	0	82638614.9871584

281	20	100	2669.6998806614483	79.26381344121835	2693.224235634743	79.30473020036388	19499.642303589666	319151.8926910767	266232.4540943771	13234467.11369445	8410.661039718972	701631.11278326	0.1	0.6011467997237275	1.1904920642326127	99501939.19419478	17697.368277337824	26440.281528073945	0	82904847.44181894
282	20	100	2651.278951484884	79.25563388793552	2674.9170236456002	79.2965443153552	19571.06548505936	319239.31964551756	264395.4496742328	13544284.431116456	8483.098149218762	710114.2109324787	0.1	0.6011647872463828	1.184419497972302	99819265.15523945	17785.168630212866	26570.708570381743	0	83169242.89205544
283	20	100	2632.985126719638	79.2474556005583	2656.7342409358116	79.28835969710745	19642.508227811097	319326.75246834307	262571.12058826524	13855960.65186617	8555.035442530616	718669.2463750093	0.1	0.6011827185672948	1.1783866998434416	100134401.5666502	17872.96898308827	26701.122154823737	0	83431814.01320149
284	20	100	2614.8175293452728	79.23927857825412	2638.6750418899824	79.28017634552299	19713.970533157895	319414.19115994714	260759.37937623484	14169506.929360094	8626.47636838712	727295.7227433964	0.1	0.6012005945017712	1.1723931673225039	100447363.53632279	17960.769335964047	26831.5222834819	0	83692573.3931317
285	20	100	2596.77528839279	79.23110282117068	2620.7385866388076	79.27199426025912	19785.452402412862	319501.6357207236	258960.1391819957	14484934.4839351	8697.424351724652	735993.1470951211	0.1	0.6012184158492146	1.166438409135244	100758166.06790882	18048.569688840187	26961.90895843797	0	83951533.53286362
286	20	100	2578.8575389028797	79.22292832884311	2602.9240410200314	79.26381344121835	19856.953836889188	319589.08615106647	257173.3137477971	14802254.603250315	8767.882793847337	744761.0298889684	0.1	0.6012361833935035	1.1605219449266224	101066824.06153466	18136.3700417167	27092.282181772985	0	84208706.84715822
287	20	100	2561.06342188445	79.21475510117426	2585.230576539665	79.25563388793552	19928.474837900158	319676.54245136975	255398.81741318578	15121478.642691066	8837.855072590673	753598.8849615591	0.1	0.6012538979033729	1.1546433049422675	101373352.31451547	18224.170394593577	27222.64195556799	0	84464105.66511394
288	20	100	2543.392084273447	79.20658313782181	2567.657370333486	79.2474556005583	20000.01540675914	319764.00462202745	253636.5651063479	15442618.025774485	8907.344542482824	762506.229504042	0.1	0.6012715601327742	1.148802029720944	101677765.52206524	18311.970747470823	27352.988281903323	0	84717742.23075889
289	20	100	2525.84267889196	79.1984124385662	2550.2036051287746	79.23927857825412	20071.575544779593	319851.4726634336	251886.4723433751	15765684.244558666	8976.354534905666	771482.5840389476	0.1	0.6012891708212286	1.1429976697976558	101980078.27800092	18399.771100348436	27483.32116285886	0	84969628.70363729
290	20	100	2508.4143644076057	79.1902430029428	2532.8684692063325	79.23110282117068	20143.155253275065	319938.9465759822	250148.4552241841	16090688.860054296	9044.888358254757	780527.4723972024	0.1	0.6013067306941743	1.137229785416936	102280305.07544187	18487.571453226417	27613.64060051425	0	85219777.15939267
291	20	100	2491.106305293193	79.1820748309771	2515.6511563627473	79.22292832884311	20214.75453355919	320026.42636006745	248422.4304258303	16417643.502638372	9112.94929809745	789640.4216952998	0.1	0.6013242404632955	1.1314979462558823	102578460.30750515	18575.371806104762	27743.94659694843	0	85468199.5903462
292	20	100	2473.91767178667	79.17390792220463	2498.550865872914	79.21475510117426	20286.37338694569	320113.91201608337	246708.31520235175	16746559.872470016	9180.540617330971	798820.9623126307	0.1	0.6013417008268519	1.1258017311566244	102874558.26799501	18663.172158983478	27874.239154240233	0	85714907.90607223
293	20	100	2456.8476398513417	79.16574227640594	2481.5668024528177	79.20658313782181	20358.011814748374	320201.40354442416	245006.0273766913	17077449.73990878	9247.665556338285	808068.627868969	0.1	0.6013591124699892	1.1201407278677735	103168613.15208873	18750.972511862557	28004.518274467788	0	85959913.93396918
294	20	100	2439.8953911363674	79.15757789348424	2464.6981762225596	79.1984124385662	20429.669818281145	320288.900945484	243315.48534055336	17410324.945936624	9314.327333143914	817382.9552021129	0.1	0.60137647606505	1.1145145327945785	103460639.05701683	18838.772864742008	28134.783959709108	0	86203229.41982608
295	20	100	2423.0601129375264	79.14941477297518	2447.9442026696415	79.1902430029428	20501.34739885799	320376.40421965707	241636.60804730013	17410324.945936624	9380.529143567832	826763.4843456807	0.1	0.6013937922718656	1.1089227507573862	103750649.98273864	18926.573217621823	28265.036212041392	0	86444866.0283861
296	20	100	2406.340998158257	79.14125291478202	2431.3041026125015	79.1820748309771	20573.044557792982	320463.91336733755	239969.3150103777	17410324.945936624	9446.274161378895	836209.7585070595	0.1	0.6014110617380524	1.103364994758137	104038659.83261435	19014.373570502008	28395.275033541722	0	86684835.34390594
297	20	100	2389.737245270965	79.13309231844055	2414.7771021642848	79.17390792220463	20644.761296400287	320551.42838891974	238313.52629886643	17410324.945936624	9511.565538447077	845721.3240455067	0.1	0.601428285099287	1.0978408857545574	104324682.41406974	19102.173923382557	28525.500426286482	0	86923148.8707102

Appendix II: Simulation Code

```
import random
import pandas as pd
import seaborn as sns


# USC Stablecoin Simulation by Alexander Kartavchenko & Mikhail Kartavchenko
# Research: "Overcoming the Stablecoin Trilemma with a New Peg Maintenance System"
# Part of the Capstone Research Initiative
#July 2024

class CapePool():
  def __init__(self, eth_amount, cape_amount, fee_percent=0.003):
    #params
    self.fee_percent = fee_percent
    self.eth_amount = eth_amount
    self.cape_amount = cape_amount
    self.constant = self.eth_amount * self.cape_amount

    #state
    self.total_cape_fee = 0
    self.total_eth_fee = 0


  def get_cape_price(self, eth_price):
     """
     Calculate the price of CAPE in terms of ETH in USD
     """

     return self.eth_amount / self.cape_amount * eth_price

  def sell_cape(self, sold_cape_amount):
    """
    Add CAPE tokens to the pool and update ETH amount according to
    (ETH_amount - x)(CAPE_amount + sold_cape_amount) = const
    Return bought ETH amount
    """

    # calculate fee and charge it
    self.total_cape_fee += sold_cape_amount * self.fee_percent
    sold_cape_amount = sold_cape_amount * (1 - self.fee_percent)

    # update pool balance
    self.cape_amount += sold_cape_amount
    updated_eth_amount = self.constant / self.cape_amount
    bought_eth_amount = self.eth_amount - updated_eth_amount
    self.eth_amount -= bought_eth_amount

    return bought_eth_amount

  def sell_eth(self, sold_eth_amount):
    """
    Remove ETH tokens from the pool and update CAPE amount according to
    (ETH_amount + sold_eth_amount)(CAPE_amount - x) = const
    Return bought CAPE amount
    """

    # calculate fee and charge it
    self.total_eth_fee += sold_eth_amount * self.fee_percent
    sold_eth_amount = sold_eth_amount * (1 - self.fee_percent)

    # update pool balance
    self.eth_amount += sold_eth_amount
    updated_cape_amount = self.constant / self.eth_amount
    bought_cape_amount = self.cape_amount - updated_cape_amount
    self.cape_amount -= bought_cape_amount

    return bought_cape_amount




# USC Stablecoin Simulation by Alexander Kartavchenko & Mikhail Kartavchenko
# Research: "Overcoming the Stablecoin Trilemma with a New Peg Maintenance System"
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#July 2024


class Treasury:
  def __init__(self, fee_percent=0.001, eth_fraction=0.4, cape_fraction=0.6):
    #params
    self.fee_percent = fee_percent
```

```
  self.cape_fraction = cape_fraction
  self.eth_fraction = eth_fraction

  # state
  self.total_eth_fee = 0
  self.total_eth_amount = 0
  self.total_cape_amount = 0
  self.total_wasted_cape_amount = 0
  self.total_printed_cape_amount = 0
  self.total_emitted_usc = 0


def buy_usc(self, eth_amount, cape_amount, eth_price, cape_price, fee=True):
  """
  Buy USC using the mixture of CAPE and ETH (the proportion of tokens is controlled outside)
  Return emitted (bought) USC amount
  """
  if fee:
    # calculate fee and charge it
    usd_amount = eth_amount * eth_price + cape_amount * cape_price
    usd_fee = usd_amount * self.fee_percent
    eth_fee = usd_fee / eth_price
    self.total_eth_fee += eth_fee
    eth_amount -= eth_fee

  usd_amount = eth_amount * eth_price + cape_amount * cape_price
  usc_amount = usd_amount

  self.total_eth_amount += eth_amount
  self.total_cape_amount += cape_amount
  self.total_emitted_usc += usc_amount

  return usc_amount

def sell_usc(self, usc_amount, eth_price, cape_price):
  """
  Sell USC for the mixture of CAPE and ETH (the proportion of tokens is controlled by Treasury)
  Return bought ETH and CAPE amount
  """
  usc_fee = usc_amount * self.fee_percent
  usd_fee = usc_fee

  usd_amount = usc_amount
  cape_amount = usd_amount * self.cape_fraction / cape_price
  eth_amount = usd_amount * self.eth_fraction / eth_price

  eth_amount -= usd_fee / eth_price

  self.total_eth_amount -= eth_amount
  self.total_cape_amount -= cape_amount
  self.total_emitted_usc -= usc_amount

  return eth_amount, cape_amount

def deposit_wasted_cape(self, cape_amount):
  """
  Deposit CAPE amount as wasted CAPE
  """
  self.total_wasted_cape_amount += cape_amount

def get_total_balance(self, eth_price, cape_price):
  """
  Calculate total balance (CAPE + ETH)
  Return balance in USD
  """
  return self.total_cape_amount * cape_price + self.total_eth_amount * eth_price

def calc_cape_fraction(self, eth_price, cape_price):
  """
  Calculate current CAPE fraction in total balance (CAPE + ETH)
  Return CAPE fraction
  """
  return self.total_cape_amount * cape_price / self.get_total_balance(eth_price, cape_price)

def calc_usc_support(self, eth_price, cape_price):
  """
  Calculate balance support per 1 emitted USC
  Return USC support
  """
  return self.get_total_balance(eth_price, cape_price) / self.total_emitted_usc
```

```
# USC Stablecoin Simulation by Alexander Kartavchenko & Mikhail Kartavchenko
# Research: "Overcoming the Stablecoin Trilemma with a New Peg Maintenance System"
# Part of the Capstone Research Initiative
#July 2024


class CapeBonder():
  def __init__(self):
    # params
    self.cape_price_discount = 0.05
    self.lock_period = 5

    # state
    self.collected_cape = 0
    self.collected_eth = 0
    self.bonded_cape_list = []

  def buy_bond(self, eth_amount, eth_price, cape_amount, cape_price):
    """
    Buy bonded CAPE with the discount
    Return bonded CAPE amount
    """
    usd_amount = eth_amount * eth_amount * eth_price +\
      cape_amount * cape_price

    cape_bonded = usd_amount / (cape_price * (1 - self.cape_price_discount))

    self.collected_cape = cape_amount
    self.collected_eth =  eth_amount
    self.bonded_cape_list.append(cape_bonded)
    return cape_bonded

  def emit_cape(self):
    """
    Emit CAPE at the correspoding simulation step if lock period has expired
    Return emitted CAPE amount
    """
    # length of bonded_cape_list equals the number os simulation steps
    simulation_step = len(self.bonded_cape_list)
    if simulation_step > self.lock_period:
      # -1 since we order list elements from 0
      return self.bonded_cape_list[simulation_step - self.lock_period - 1]
    else:
      return 0


# USC Stablecoin Simulation by Alexander Kartavchenko & Mikhail Kartavchenko
# Research: "Overcoming the Stablecoin Trilemma with a New Peg Maintenance System"
# Part of the Capstone Research Initiative
#July 2024


class Merchant():
  def __init__(self):
    #params
    self.reserve_percent = 0.3
    self.daily_interest_rate = 0.035 / 365
    self.borrow_rate = 0.3

    #state
    self.reserved_eth = 0
    self.staked_eth = 0
    self.earned_eth = 0
    self.already_borrowed_eth = 0


  def add_eth(self, eth_amount):
    """
    Add ETH to reserves and staking
    """
    # 30% of ETH goes to reserves, 70% to staking
    self.reserved_eth += self.reserve_percent * eth_amount
    self.staked_eth += (1 - self.reserve_percent) * eth_amount

  def earn_interest(self):
    """
    Earn interest from staked ETH
    Return earned interest in ETH
    """
    daily_interest = self.staked_eth * self.daily_interest_rate
    self.earned_eth += daily_interest
    self.reserved_eth += self.reserve_percent * daily_interest
    self.staked_eth += (1 - self.reserve_percent) * daily_interest
```

```
    return daily_interest

  def deposit_to_treasury(self, treasury, required_loan_eth, cape_price, eth_price):
    """
    Process loan accoring to the guideliness
    """
    # if we can fully take ETH loan from Merchant
    if required_loan_eth + self.already_borrowed_eth <= self.borrow_rate * self.staked_eth:
      treasury.total_eth_amount += required_loan_eth
      self.already_borrowed_eth += required_loan_eth
      self.reserved_eth += self.reserve_percent * required_loan_eth
      self.staked_eth += (1 - self.reserve_percent) * required_loan_eth

    else:
      possible_loan_eth = self.borrow_rate * self.staked_eth - self.already_borrowed_eth
      # if we can partially take ETH loan from Merchant
      if possible_loan_eth > 0:
        treasury.total_eth_amount += possible_loan_eth
        self.already_borrowed_eth += possible_loan_eth
        self.reserved_eth += self.reserve_percent * possible_loan_eth
        self.staked_eth += (1 - self.reserve_percent) * possible_loan_eth

      else:
        required_loan_cape = required_loan_eth * eth_price / cape_price
        treasury.total_cape_amount += required_loan_cape



# USC Stablecoin Simulation by Alexander Kartavchenko & Mikhail Kartavchenko
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class TreasuryCreditModule():
  def __init__(self, lock_period=90, max_interest_rate=0.10):
    # params
    self.lock_period = lock_period
    self.max_interest_rate = max_interest_rate

    # state
    self.deposited_usc_list = []
    self.total_usc_balance = 0
    self.rewards_pool_usc = 0
    self.total_dividends = 0
    self.total_potentially_removable_usc = 0


  def deposit(self, usc_amount):
    """
    Deposit USC amount to the balance
    """
    self.deposited_usc_list.append(usc_amount)
    self.total_usc_balance += usc_amount

  def allocate_rewards_pool(self, usc_amount):
    """
    Allocate rewards pool
    """
    self.rewards_pool_usc += usc_amount

  def pay_dividends(self):
    """
    Pay daily dividends using dynamic interest rate
    Return dividends and calculated interest rate (yearly)
    """
    # dynamic interest rate
    calculated_interest_rate = min(self.rewards_pool_usc / self.total_usc_balance, self.max_interest_rate)

    # calculate devidends for 1 day
    dividends = self.total_usc_balance * calculated_interest_rate / 365

    # pay dividends from reward pool
    self.total_dividends += dividends
    self.rewards_pool_usc -= dividends

    return dividends, calculated_interest_rate

  def potentially_removable_usc_cum(self):
    """
    Calculate cumulative potentially removable USC at the correspoding simulation step if lock period has expired
    Return cumulative amount of potentially removable USC
```

```
    """

    # length of deposited_usc_list equals the number of simulation steps
    simulation_step = len(self.deposited_usc_list)
    if simulation_step > self.lock_period:
      # -1 since we order list elements from 0
      # add usc that can be removed to total cumulative usc sum
      self.total_potentially_removable_usc += self.deposited_usc_list[simulation_step - self.lock_period - 1]

    return self.total_potentially_removable_usc


# USC Stablecoin Simulation by Alexander Kartavchenko & Mikhail Kartavchenko
# Research: "Overcoming the Stablecoin Trilemma with a New Peg Maintenance System"
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#July 2024


cape_pool = CapePool(eth_amount=10**6, cape_amount=10**6)
cape_bonder = CapeBonder()
merchant = Merchant()
treasury = Treasury()
bank = TreasuryCreditModule()
merchant.add_eth(cape_pool.eth_amount)
records = []

usc_just_held_by_people = 0

eth_price = 1566.86

for t in range(298):



    # FIRST INCOMING FLOW; change by Misha: no 80% CAPE 20% ETH & wasted cape anymore, ratio is the same as in Treasury


    #ETH is increasing in price from t = 1 to t = 151, that is from October 12th 2023 to March 11th 2024

    if 1 <= t <= 151:
      eth_price *= (1 + 0.63 / 100)

    #ETH is decreasing in price from t = 152 to t = 184, that is from Mach 12th 2024 to April 13th 2024

    if 152 <= t <= 184:
      eth_price *= (1 - 0.94 / 100)

    #ETH is increasing in price from t = 185 to t = 228, that is from April 13th 2024 to May 27th 2024

    if 185 <= t <= 228:
      eth_price *= (1 + 0.60 / 100)

    #ETH is decreasing in price from t = 229 to t = 298, that is from May 28th 2024 to August 5th 2024

    if 229 <= t <= 298:
      eth_price *= (1 - 0.69 / 100)




    eth_to_bonder = 20

    # register ETH at Merchant
    merchant.add_eth(eth_to_bonder)

    # exchange 60% of ETH to CAPE in CapePool
    bought_cape_amount = cape_pool.sell_eth(0.6 * eth_to_bonder)
    cape_price = cape_pool.get_cape_price(eth_price)

    # buy bonded CAPE using 40% of ETH and 60% of CAPE
    cape_bonded = cape_bonder.buy_bond(0.4 * eth_to_bonder, eth_price, bought_cape_amount, cape_price)

    # exchange from bonder to treasury in the same proportion (ETH 40% to CAPE 60%)
    eth_to_exchange = cape_bonder.collected_eth
    cape_to_exchange = cape_bonder.collected_cape

    # buy USC in treasury
    usc_bought_by_bank = treasury.buy_usc(eth_to_exchange, cape_to_exchange, eth_price, cape_price, fee=False)

    # allocate USC to Bank's reward pool
```

```
bank.allocate_rewards_pool(usc_bought_by_bank)

# reset Bonder's balance
cape_bonder.collected_eth = 0
cape_bonder.collected_cape = 0


# check usc_support condition
usc_support = treasury.calc_usc_support(eth_price, cape_price)


# Third Incoming Flow
eth_for_third_flow = 100  # You can specify the amount of ETH to be used

# Calculate the amount of CAPE needed to meet the treasury's ratio
cape_needed = eth_for_third_flow * treasury.cape_fraction / treasury.eth_fraction

# Register ETH at Merchant (if needed)
merchant.add_eth(eth_for_third_flow)

# Buy the necessary CAPE from CapePool
cape_acquired = cape_pool.sell_eth(eth_for_third_flow * treasury.cape_fraction / (treasury.cape_fraction + treasury.eth_fraction))

# Buy USC using specified ETH and acquired CAPE
usc_bought_by_people_at_this_step = treasury.buy_usc(
    eth_for_third_flow * treasury.eth_fraction / (treasury.cape_fraction + treasury.eth_fraction),
    cape_acquired,
    eth_price,
    cape_pool.get_cape_price(eth_price)
)

# Update the amount of USC held by people
usc_just_held_by_people += usc_bought_by_people_at_this_step



# SECOND INCOMING FLOW - only execute if usc_support < 2
if usc_support < 1.5:
  eth_to_bank = 100

  # register ETH at Merchant
  merchant.add_eth(eth_to_bank)

  # exchange 60% of ETH to CAPE
  cape_bought = cape_pool.sell_eth(0.6 * eth_to_bank)

  # buy USC in treasury (40% ETH and 60% CAPE)
  usc_to_bank = treasury.buy_usc(0.4 * eth_to_bank, cape_bought, eth_price, cape_pool.get_cape_price(eth_price))

  # deposit USC to Bank
  bank.deposit(usc_to_bank)

  # reduce Treasury emitted USC balance
  treasury.total_emitted_usc -= usc_to_bank


else:
  eth_to_bank = 0
  usc_to_bank = 0
  bank.deposit(usc_to_bank)


# OTHER ROUTINE
daily_interest = merchant.earn_interest() #remove from condition
bank.allocate_rewards_pool(daily_interest) #remove from condition

# control treasury balance
if treasury.calc_usc_support(eth_price, cape_price) < 1:
    current_balance_usd = treasury.get_total_balance(eth_price, cape_price)
    usc_balance = treasury.total_emitted_usc

    # we want to have support >= 1
    required_loan_usd = usc_balance - current_balance_usd
    required_loan_eth = required_loan_usd / eth_price

    # merchant deposits to treasury
    merchant.deposit_to_treasury(treasury, required_loan_eth, eth_price, cape_price)


potentially_removable_usc_cum = bank.potentially_removable_usc_cum()
daily_dividends, daily_interest_rate = bank.pay_dividends()

cape emitted = cape bonder.emit cape()
```

```
    cape_pool.sell_cape(cape_emitted)
    cape_fraction = treasury.calc_cape_fraction(eth_price, cape_price)
    usc_support = treasury.calc_usc_support(eth_price, cape_price)

    records.append((
    eth_to_bonder, eth_to_bank, eth_price, cape_bonded, cape_price, cape_emitted,
    merchant.earned_eth, merchant.reserved_eth, usc_to_bank, potentially_removable_usc_cum,
    daily_dividends, bank.total_dividends, daily_interest_rate,
    cape_fraction, usc_support, treasury.total_emitted_usc,
    treasury.total_eth_amount, treasury.total_cape_amount,
    merchant.already_borrowed_eth, usc_just_held_by_people, usc_bought_by_people_at_this_step
    ))



results = pd.DataFrame(records, columns=[
    'eth_to_bonder', 'eth_to_bank', 'eth_price', 'cape_bonded', 'cape_price', 'cape_emitted',
    'merchant.earned_eth', 'merchant.eth_amount', 'usc_to_bank', 'potentially_removable_usc',
    'daily_dividends', 'total_dividends', 'daily_interest_rate',
    'cape_fraction', 'usc_support', 'emitted_usc',
    'treasury.total_eth_amount', 'treasury.total_cape_amount',
    'already_borrowed_eth', 'usc_just_held_by_people', 'usc_bought_by_people_at_this_step'
])


results.head(298).loc[:, [
    'eth_to_bonder', 'eth_to_bank', 'eth_price', 'cape_bonded', 'cape_price', 'cape_emitted',
    'merchant.earned_eth', 'merchant.eth_amount', 'usc_to_bank', 'potentially_removable_usc',
    'daily_dividends', 'total_dividends', 'daily_interest_rate',
    'cape_fraction', 'usc_support', 'emitted_usc',
    'treasury.total_eth_amount', 'treasury.total_cape_amount',
    'already_borrowed_eth', 'usc_just_held_by_people', 'usc_bought_by_people_at_this_step'
]]
```