PERA TOKEN SMART CONTRACT

TEST REPORT

LP Token Staking Tests

PERA LP TOKEN STAKING

1- Check the number of LP tokens staked in the PERA smart contract, ***totalStakedLP***

2- Check the amount of tokens minted in each block for LP token stakers, ***blockRewardLP***

3- Check the amount of mint rewards when the LP token staker reward multiplier is changed, ***LPRewardMultiplier***

4- Check the 0.75% transaction fee rewards collected for LP token stakers, ***FeeRewPoolLP***

5- Check the last block number of any LP token staker's deposit/withdraw, ***lastRewardBlock***

6- Check the LP token amount sent to when LP token stakers withdraw LP tokens, ***transferFrom***

7- Check the reward calculations in case of stakers' additional LP token deposits

8- Check that the staked LP tokens are correctly added to the PERA smart contract balance

FINANCIAL ARCHITECTURE OF LP TOKEN STAKING

9- Check whether another token not defined in the smart contract can be staked as LP token, ***depositLPtoken***

10- Check that the LP token balance of each LP token staker is calculated correctly, ***userInfo***

11- Check that the staker block rewards are minted in the correct amount, ***pendingPERA, updateRate***

12- Check whether LP token staker rewards are distributed to stakers in proportion to the amount of LP tokens they stake, ***withdraw***

13- Check whether the transaction fails when a user wants to withdraw more than their staked amount, ***withdraw***

14- When a user has previously staked LP tokens and wants to stake more LP tokens, check the reward amount sent to the user, ***deposit***

15- Check the reward calculations in case of stakers' partial LP token withdrawals, ***withdraw***

16- Check the reward amount earned from mints (block rewards) and transaction fees of users who withdraw all of their LP tokens

17- Check the ***emergencyWithdraw*** function for users who only want to withdraw LP tokens without receiving LP staker rewards, ***emergencyWithdraw***

18- Check that LP token staker transaction fee rewards are not collected when there is no LP token staked in the PERA smart contract

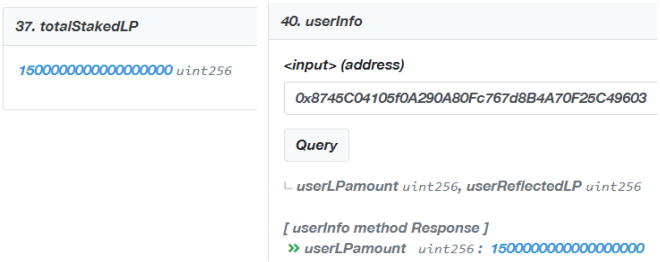
PERA LP token staking tests were conducted under 2 different stages; testing the mathematical and financial infrastructure and unit testing of LP token staking related functions. You can find the scenario applied for the tests of the first stage in the table below. Details of the transactions made during the tests are given in the table. Transactions can be followed from:
https://testnet.bscscan.com/address/0xf07c3309a1b3ba630fff7c6f2e2a486471f479c6#transactions
https://testnet.bscscan.com/address/0xb79c1cd3de9c2b7e2ff363af9bdb7fe562db765d#transactions
The steps described in the PERA Smart Contract Deployment Guide have been followed for contract deployment. Subsequently, the contract owner added initial liquidity on the BakerySwap testnet. The transactions stated in the table have been carried out over the BakerySwap liquidity.

List of Users	
Wallet-1	AbF
Wallet-2	603
Wallet-3	D10
Wallet-4	70f
Wallet-5	055
Wallet-6	2f6
Wallet-7	a92

Tx-ID	User-ID	Wallet-ID	Tx Type	Tx Amount	# of Tx Block	Tx Hash
1	2	603	Buy	5000		https://testnet.bscscan.com/tx/0x5739a8475abcb7ca64f94c1e36f77319130d1ee599771e292bf723d6ba0aa78e
2	2	603	Add Liq	2500		https://testnet.bscscan.com/tx/0xadf68042af0ea8494ca51f7729f2be833893fa92bfe6032c1119fee17a8101fd
3	**2**	**603**	**Stake LP**	**1.5**	8431558	**https://testnet.bscscan.com/tx/0xfa4b9da5f9d119e700eb00ad94545ea4ea1fdbfb74800ebcd819d565ffbed149**
4	4	70f	Buy	40000		https://testnet.bscscan.com/tx/0x604004ff125ee1dd4c64a3d5e0a4c7c6c58515d7a7bd9f07867c1838237f310f
5	4	70f	Add Liq	35000		https://testnet.bscscan.com/tx/0x816b77f1bc742bcbf1eff5ae919093269449eafef8076c2260bf0101b6406808
6	3	D10	Buy	11000		https://testnet.bscscan.com/tx/0x4b21cd8e6e2f6ade7045ecb49727c93b2544bc1eacccaa0fa875713936fbc533
7	**2**	**603**	**Stake LP**	**8.5**	8431786	**https://testnet.bscscan.com/tx/0xfaddbdda43e3235717d27888c6e2be71c2f1aefbde0217e1fc52471cc9e2ebce**
8	5	055	Buy	15333		https://testnet.bscscan.com/tx/0x44727665fb6a725f0c91cf699edf4251b432d0003f70e3f4db43ae9f4100e337
9	3	D10	Transfer	10000		https://testnet.bscscan.com/tx/0x9a4ceb341eb1a46980e4e9deb9e62a744cd6917ea506d1c873bbe0b520f823df
10	**1**	**AbF**	**Stake LP**	**40**	8431959	**https://testnet.bscscan.com/tx/0xf9db1a85b290ac2276cb55daa9b5d235ffe61f7c20aa2fbdcf8348ba0c9640c1**
11	**2**	**603**	**Unstake LP**	**2**	8432098	**https://testnet.bscscan.com/tx/0xc02e789445f276df27396f831db0e13a8cd0389511203a86fb02703963738ebe**
12	6	2f6	Sell	9750		https://testnet.bscscan.com/tx/0x566eb3d584186c2d2f715d1be3931ca424ac3fbd4ad4fd2ca2f569233ed2cf07
13	5	055	Add Liq	15000		https://testnet.bscscan.com/tx/0x6623c8d5df9f08b98237c200590f9b4290ace0c673be07ac7c9bbd8b2fe3db78
14	**5**	**055**	**Stake LP**	**50**	8432295	**https://testnet.bscscan.com/tx/0xed37dd37653c55aaeda183a9a8c3291112229e90d703978e068fbf37ebc87dbf**
15	7	a92	Buy	50000		https://testnet.bscscan.com/tx/0xb8685670aa37489682356f41404061f9b2d8472abc248626a2a0c68dfd1b2b32
16	7	a92	Add Liq	40000		https://testnet.bscscan.com/tx/0xc5802e165bb0a062ce39ca45bfa7defa079ada19d30c79a90dc29ce2204929e8
17	4	70f	Sell	4000		https://testnet.bscscan.com/tx/0xa450138eec1c4078c22157cab644f702f404b12431d1e6342712dae488748b4d
18	7	a92	Remove Liq	19615.4277498977		https://testnet.bscscan.com/tx/0x65ac9dd8612b4f13a8052af237cf8240288f6b8fc9a7c48cc08e7d6a53e830d5
19	**5**	**055**	**Unstake LP**	**50**	8432595	**https://testnet.bscscan.com/tx/0xcdc0ef85bd98ecff6720f00fcd47bad3bfea81e3268ca03b36fe864cb416866b**
20	2	603	Sell	1000		https://testnet.bscscan.com/tx/0x439deb8af8aa19f1c99ac0c55bb4da7c1eb9500c972975797c2382d2fe1788b2
21	7	a92	Transfer	8000		https://testnet.bscscan.com/tx/0x42a5c21bbf43337312171b33fc4d2839555ea11c11e5efeac05165d536a5ef55
22	**1**	**AbF**	**Unstake LP**	**20**	8432839	**https://testnet.bscscan.com/tx/0x7c1413d060a90c5fa406ef9558ec728f996cf8a69d9ea5dd5e718328ab4f85cf**
23	3	D10	Buy	750		https://testnet.bscscan.com/tx/0xd694c122b51ca352d8e01619b2414b1f8e74876588d8ff801eb00726317a4a3e
24	**2**	**603**	**Stake LP**	**2**	8432938	**https://testnet.bscscan.com/tx/0x59fe53eeae81307aedcf5bb2a5d6c93b4c3d720b8ab4aee07cf37f782e95addd**
25	**1**	**AbF**	**Unstake LP**	**20**	8432999	**https://testnet.bscscan.com/tx/0x9d0e41389cb4a9a7cdccf08cdad58db4046af551dc525d35db612b63af426712**
26	2	603	Sell	250		https://testnet.bscscan.com/tx/0xe0375e9bea55e889fd33942466221efb3ad4c5a669b974fa18f1cd3046e0d32b
27	**2**	**603**	**Unstake LP**	**10**	8433107	**https://testnet.bscscan.com/tx/0xee97a14474b90a8c20c34214333b44f9b8cb5449023a2426f46a555a94480c29**

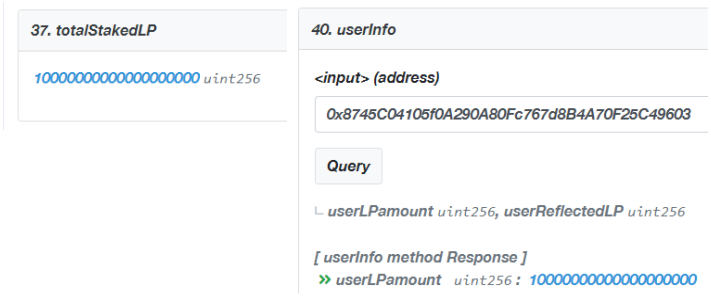
Check-18- Before any user staked their LP tokens, we have made 2 transactions (Tx-1 and Tx-2) to check that the 0.75% amount received for LP token staker rewards was not taken if there is no LP token staked in the smart contract.

Checks-1/10- In the Tx-3, Wallet-2 stakes 1.5 LP tokens. After the transaction, the amount staked by the user and the total amount of LP tokens staked in the smart contract were checked.



Check-4- The next staking event is carried out in Tx-7. Until this transaction, 2 buy and 1 liquidity addition transactions had been made on the BakerySwap testnet pool, including 40.000, 35.000. and 11.000 tokens.

Checks-2/7/8/11/14- On Tx-7, Wallet-2 who staked 1.5 LP tokens in Tx-3 stakes another 8.5 LP tokens. At this stage, the LP token balance of the smart contract and Wallet-2 must be 10.



- Deposit of additional LP tokens by a user who already has staked LP tokens in the smart contract requires sending the rewards the user should have received so far. The rewards collected from transaction fees and block mint rewards must be calculated in order to test the amount of rewards sent to the staker.

- From 3 transactions that have been made during the time when the user's LP tokens were in stake, a 0.75% fee should be allocated from each of these transactions. The total amount of reward received is

$$\text{Wallet-2 Tx Fee Rewards} = 0.0075 * (40.000 + 35.000 + 11.000)$$
$$= 645 \text{ Tokens}$$

- Wallet-2 has been on stake between the blocks 8431558 and blocks 8431786, and there were no other stakers within the interval. Tested smart contract mints 0.5 PERA tokens/block for the LP token staker rewards. Total mint reward for the user can be calculated as

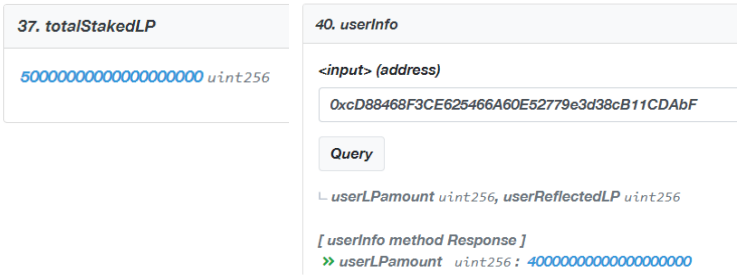
$$\text{Wallet-2 Mint Rewards} = 0.5 * (8431786 - 8431558)$$
$$= 114 \text{ Tokens}$$

- In total, the staker should receive

$$\text{LP Token Staker Total Rewards} = 645 + 114$$
$$= 759 \text{ Tokens}$$

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.
https://testnet.bscscan.com/tx/0xfaddbdda43e3235717d27888c6e2be71c2f1aefbde0217e1fc52471cc9e2ebce

Check-12- After Wallet-2 stakes more LP tokens, 1 buy and 1transfers transactions have been made until Tx-10 where Wallet-1 starts staking with 40 LP tokens. At this stage, the smart contract must have a balance of 50 LP tokens and Wallet-1 40.



Check-5/6/12/15- In Tx-11, Wallet-2 withdraws 2 of the 10 LP tokens it stakes. At this stage, the rewards earned so far from the point where the 2nd wallet received the previous reward must be calculated and sent to the user. While the share of Wallet-2 in the LP staking pool is 100% between the blocks 8431786 and 8431959, after the 2nd staker (Wallet-1) comes, the pool share between the blocks 8431959 and 8432098 should be calculated again and user's total rewards should be calculated accordingly.

- 2 transactions were made between Tx-7 and Tx-11. Within this interval, Wallet-2 is the only owner of the fee rewards from these transactions.

$$\text{Wallet-2 Tx Fee Rewards} = 0.0075 * (15.333 + 10.000)$$
$$= 189.9975 \text{ Tokens}$$

- Wallet-2 is the only owner of the mint rewards generated between the blocks 8431786 and 8431959, while the pool share between the blocks 8431959 and 8432098 must be recalculated. During the 2nd interval, Wallet-2 has 10 LP tokens in stake and total LP token staked in the smart contract is 50. Accordingly, the total mint reward that Wallet-2 will receive

$$\text{Wallet-2 Mint Rewards} = 0.5 * (8431959 - 8431786) + (10/50) * 0.5 * (8432098 - 8431959)$$
$$= 100.4 \text{ Tokens}$$

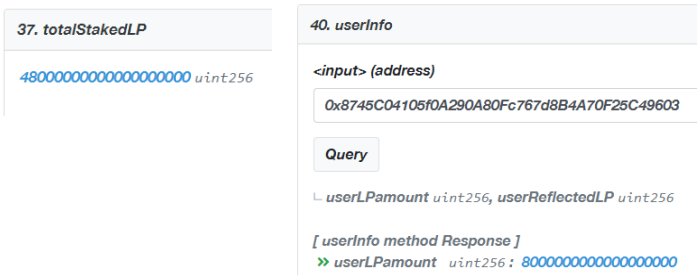
- In total, the staker should receive

$$\text{Wallet-2 Total Rewards} = 189.9975 + 100.4$$
$$= 290.3975 \text{ Tokens}$$

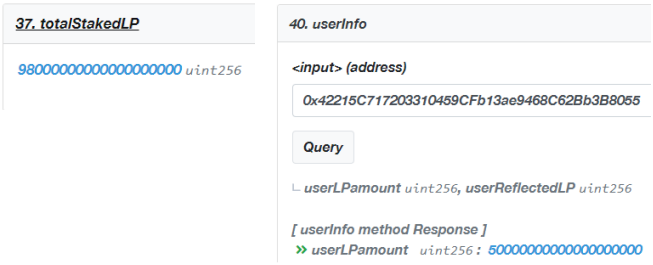
- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0xc02e789445f276df27396f831db0e13a8cd0389511203a86fb02703963738ebe

- After the transaction, the amount staked by the user should be 8 LP tokens where the total amount of LP tokens staked in the smart contract should be 48.



- After 1 sell and 1 liquidity addition, a 3rd staker (Wallet-5) starts staking with 50 LP tokens on Tx-14. After this process, there must be 50 LP tokens belonging to Wallet-5 and 98 LP tokens staked in the smart contract.



Check-16- The next reward claim event is held on Tx-19 where Wallet-5 withdraws all of the staked 50 LP tokens. Between the blocks 8432295 and 8432595 there are 3 LP token stakers in the smart conract. Considering the user's pool share, the total reward calculation for Wallet-5 is

$$\text{Wallet-5 Tx Fee Rewards} = 0.0075 * (50000 + 40000 + 4000 + (19615.4277498977 + 19223.1191948997))$$
$$= 508.310766370398 \text{ Tokens}$$

and

$$\text{Wallet-5 Mint Rewards} = (50/98) * 0.5 * (8432595 - 8432295)$$
$$= 76.530612244898 \text{ Tokens}$$

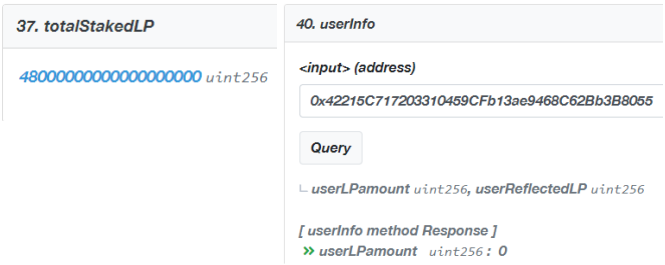
- In total, the staker should receive

$$\text{Wallet-5 Total Rewards} = 508.310766370398 + 76.530612244898$$
$$= 584.841378615296 \text{ Tokens}$$

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0xcdc0ef85bd98ecff6720f00fcd47bad3bfea81e3268ca03b36fe864cb416866b

- After the transaction, the amount staked by Wallet-5 should be 0 where the total amount of LP tokens staked in the smart contract should be 48.



- Next reward claim event occurs in Tx-22 where Wallet-1 withdraws 20 out of total 40 staked LP tokens. Each deposit and withdraw event causes a change in the pool share of each user. Between the interval where Wallet-1 has been in staking, user's pool share changes 4 times.

Considering the user's pool share in each interval, the total reward calculation for Wallet-5 is

Wallet-1 Tx Fee Rewards = 0.0075 * [(40/48) * (9.750 + 15.000) + (40/98) * (50.000 + 40.000 + 4000 + (19615.4277498977 + 19223.1191948997)) + (40/48) * (1000 + 8000)] = 617.586113096319 Tokens

and

Wallet-1 Mint Rewards = (40/50) * 0.5 * (8432098 – 8431959) + (40/48) * 0.5 * (8432295 – 8432098) + (40/98) * 0.5 * (8432595 – 8432295) + (40/48) * 0.5 * (8432839 – 8432595) = 300.574489795918 Tokens

- In total, the staker should receive

Wallet-1 Total Rewards = 617.586113096319 + 300.574489795918
= 918.160602892237 Tokens

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0x7c1413d060a90c5fa406ef9558ec728f996cf8a69d9ea5dd5e718328ab4f85cf

- After the transaction, the amount staked by Wallet-1 should be 20 where the total amount of LP tokens staked in the smart contract should be 28.

- After 1 buy transaction, Wallet-2 adds 2 more LP tokens into staking. The rewards won by the user between Tx-11 and Tx-24 must be calculated taking into user's changing pool share within the interval.

Wallet-2 Tx Fee Rewards = 0.0075 * [(8/48) * (9.750 + 15.000) + (8/98) * (50.000 + 40.000 + 4000 + (19615.4277498977 + 19223.1191948997)) + (8/48) * (1000 + 8000) + (8/28) * (750)] = 125.124365476407 Tokens

and

Wallet-2 Mint Rewards = (8/48) * 0.5 * (8432295 – 8432098) + (8/98) * 0.5 * (8432595 – 8432295) + (8/48) * 0.5 * (8432839 – 8432595) + (8/28) * 0.5 * (8432938 – 8432839) = 77.280612244898 Tokens

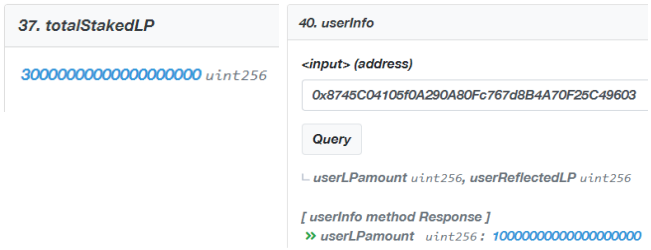
- In total, the staker should receive

Wallet-2 Total Rewards = 125.124365476407 + 77.280612244898
= 188.262120578447 Tokens

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0x59fe53eeae81307aedcf5bb2a5d6c93b4c3d720b8ab4aee07cf37f782e95addd

- After the transaction, the amount staked by Wallet-2 should be 10 where the total amount of LP tokens staked in the smart contract should be 30.



- In the next transaction, Wallet-2 withdraws 20 LP tokens. Wallet-1's reward after this transaction can be calculated as follows.

Wallet-1 Tx Fee Rewards = 0.0075 * (20/28) * (750) = 4.01785714285714 Tokens

and

Wallet-1 Mint Rewards = (20/28) * 0.5 * (8432938 – 8432839) + (20/30) * 0.5 * (8432999 - 8432938)
= 55.6904761904762 Tokens

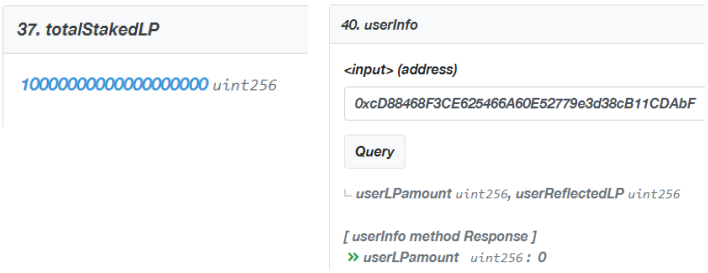
- In total, the staker should receive

Wallet-1 Total Rewards = 4.01785714285714 + 55.6904761904762 = 59.7083333333333 Tokens

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0x9d0e41389cb4a9a7cdccf08cdad58db4046af551dc525d35db612b63af426712

- After the transaction, the amount staked by Wallet-1 should be 0 where the total amount of LP tokens staked in the smart contract should be 10.



- After one last transaction, Wallet-2 withdraws 10 LP tokens that it staked at Tx-27. Wallet-2's reward after this transaction can be calculated as follows.

Wallet-2 Tx Fee Rewards = 0.0075 * 250 = 1.875 Tokens

and

Wallet-2 Mint Rewards = (10/30) * 0.5 * (8432999 – 8432938) + * 0.5 * (8433107 - 8432999)

= 64.1666666666667 Tokens

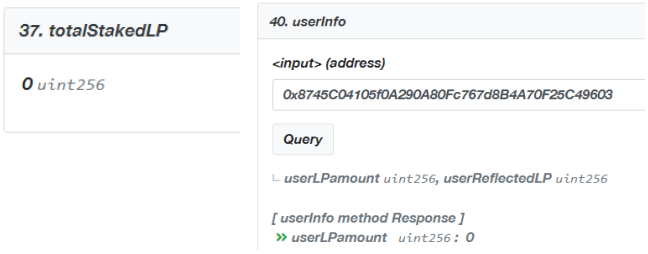
- In total, the staker should receive

Wallet-2 Total Rewards = 1.875 + 64.1666666666667 = 66.0416666666667 Tokens

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0xee97a14474b90a8c20c34214333b44f9b8cb5449023a2426f46a555a94480c29

- After the transaction, the amount staked by Wallet-1 should be 0 where the total amount of LP tokens staked in the smart contract should be 0.



Check-3- Block mint rewards for LP token stakers have been updated from 0.5 PERA / block to 1 PERA / block. You can find the transaction in the link below.

https://testnet.bscscan.com/tx/0xc1b8ab4e4f2d5dfb73e8acd161216eaadccab03193d275fca830c7b8fd6a8f49

- After the update was done, Wallet-2 started staking with 10 LP tokens and remained in staking between blocks 8458516 - 8458574. It has been checked whether block mint rewards have been updated accordingly.

Deposit and Withdraw Transactions

https://testnet.bscscan.com/tx/0xa032141eaad23a1a44342a43179e9b3cd1ba0a1cd2608b311000cfd85ac012ab

https://testnet.bscscan.com/tx/0x675ab00e17f838c89be2f07936e60fc627bfeac28cedf05aa871ae50dc49fcf8

- After the withdrawal, Wallet-2 should receive

Wallet-2 Mint Rewards = 1 * (8458574 - 8458516) = 58 Tokens

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0x675ab00e17f838c89be2f07936e60fc627bfeac28cedf05aa871ae50dc49fcf8

Check-9- In case the LP token balance in the Wallet-2 is zero, the transaction fails when user tries to stake LP token.

https://testnet.bscscan.com/tx/0xa8b964593677986107a9dc2aaac1d0415032a6813986e399fc53c8f7ff480d42

Check-13- After staking 10 LP tokens, Wallet-3 tries to withdraw 10.000000000000000001 (the smallest possible amount that is greater than the amount the user staked) LP tokens from the smart contract and the transaction fails. When the withdraw amount is set to 10, Wallet-3 was able to withdraw the staked LP tokens. You can find the deposit, failed withdraw and passed withdraw transaction links below.

https://testnet.bscscan.com/tx/0xfbc24acce6a6a3f54fd6c36cdba837c6d0b15c9a0dd547c51d47617f6e4ff47e

https://testnet.bscscan.com/tx/0x1b798eafc64914523bf72afa09af009eae459c71d7f2276c92dd816f19d7dd90

https://testnet.bscscan.com/tx/0x2b45ef62e796f9bbf422e72a499d9f671b26f39b1275595b66166451d6b3a281

Check-17- Wallet-3 uses the emergencyWithdraw function to withdraw only its staked LP tokens without receiving rewards. During this process, no reward should be sent to the user, but only staked LP tokens should be sent. You can find the link of the transactions below.

https://testnet.bscscan.com/tx/0xe5564758143580750 61b2ad8295d0bfc2714942c6c5bafd91fc7e0c37260f8f1

https://testnet.bscscan.com/tx/0xa697d14db7b0735eaadd7bf2a00dc11cd2fc8e26f3717d5f58dff37d9c700f64

- In order to check that there is no disruption in the reward distribution mechanism after the emergency withdrawal, the reward amount claimed by the user was checked after 10 LP tokens were staked by Wallet-3. LP tokens remian in the staking between the blocks 8459597 and 8459612.

https://testnet.bscscan.com/tx/0x1341431679cc8c41db61287b039f43df271a69d8c5e54b7800ce5986fc2e636c

- After the withdrawal, Wallet-3 should receive

Wallet-3 Mint Rewards = 1 * (8459612 - 8459597) = 15 Tokens

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0xf9116457a3dae51673d7640dc1f27e94e8045861e1988eb8b3aab0d838b82932

- Finally, after the LP token staker block mint reward coefficient was set to zero, it was checked whether users continue to receive mint rewards. Wallet-3 has staked 10 LP tokens between the blocks 1-10. During the interval, a transfer transaction including 1000 PERA tokens have also been made. Wallet-3's reward after the withdrawal transaction can be calculated as follows.

Wallet-3 Tx Fee Rewards = 0.0075 * 1000 = 7.5 Tokens

and

Wallet-3 Mint Rewards = 0 Tokens

- In total, the staker should receive

Wallet-3 Total Rewards = 7.5 Tokens

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

Set LP token staker blok mint rate to zero:

https://testnet.bscscan.com/tx/0x00c351224cf03658b18978aca1f4c5bd711122039790d963e8bdf99bb01dd5f4

Deposit: https://testnet.bscscan.com/tx/0xce09b6e9fa0a5c20cb70ba2d4fb0579bde03f3371bd22093716f260899ae2b62

Transfer: https://testnet.bscscan.com/tx/0x30a9b669aed6e8fd58d8489090599acb1c05257c72e24c4d6a37332807da8a93

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0x66bbcffcc0674e61e89e20b4cdfcf9f3d15cb3105a4b556b017ff5e5e2c50643

Trading Competition Tests

PERA DAILY TRADING COMPETITION

1- Check that the trading competition is reset in the specified periods, ***BlockSizeForTC***

2- Check the trading competition weekly reward claim schedule, ***oneWeekasBlock***

3- Check the amount of trading competition mint rewards, ***dailyRewardForTC***

4- Check the amount of mint rewards when the trading competition reward multiplier is changed, ***TCRewardMultiplier***

5- Check the minimum transaction amount required to participate in the trading competition, ***minTCamount***

6- Check that the trading competition rewards are calculated correctly for each day, ***totalRewardforTC***

7- Check the trading competition transaction fee rate, ***tradingCompFee***

8- Check whether changes in the trading competition minimum participation amount are reflected in the calculations, ***updateminTCamount***

9- Check if a user who claimed the trading competition rewards is unable to withdraw the same prize again, ***isPaid***

10- Check that users who have made transactions during the day are added to the daily traders list, ***isTraderIn***

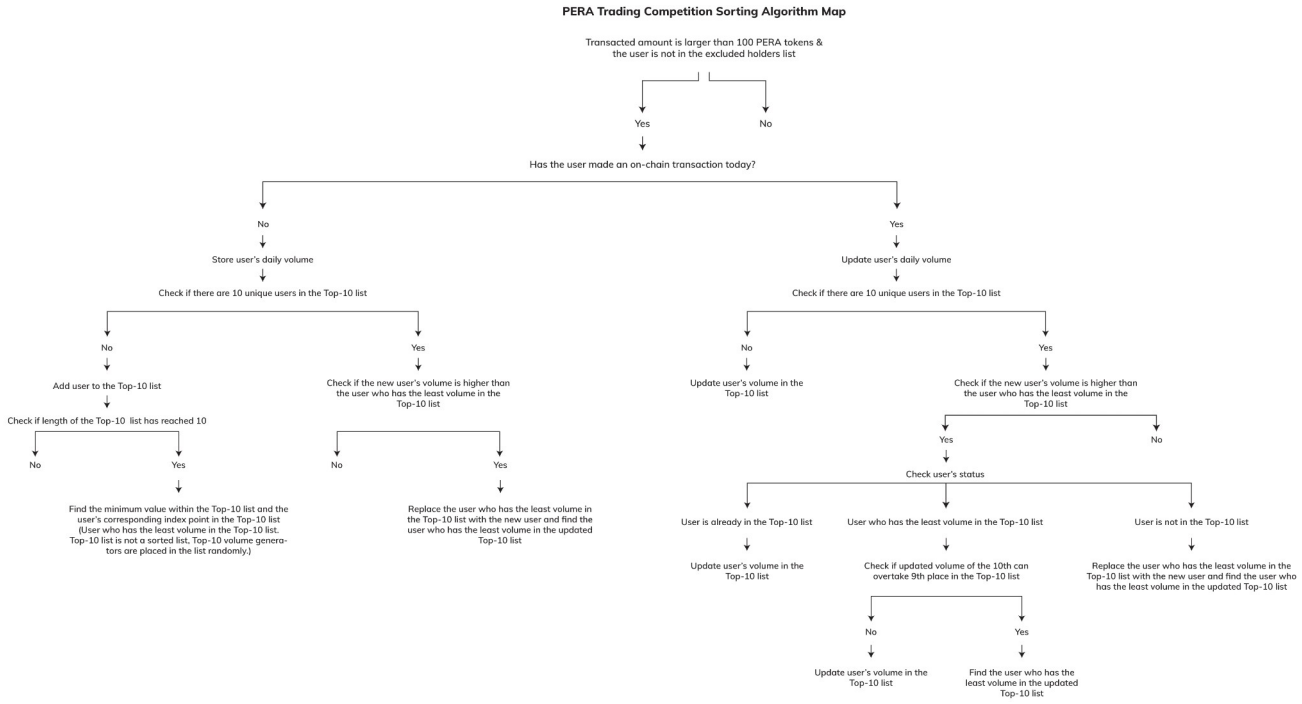
11- Check the users' addresses and daily volumes after each transaction in the list where the 10 users that create the most volume of the day are kept in an unsorted manner, ***tTraders*** (unsorted Top-10 traders list)

12- Check the index value and daily volume of the user with the lowest volume in the unsorted Top-10 traders list, ***findTLast***

13- Check trading competition rankings after each transaction, ***sortTraders***

FINANCIAL ARCHITECTURE OF THE TRADING COMPETITION

The diagram in below shows the architecture of the PERA daily trading competition *filter-and-sort* algorithm. Algorithm tests are designed to check the probabilities arising from each branch point shown in the diagram.



14- Check whether the accounts excluded are participating in the competition, ***tTraders*** (unsorted Top-10 traders list)

15- Check that user volumes are updated correctly, ***tcdetailz***

16- Check whether users who make transactions for the first time during the day have been added to the list if there are not 10 users in the unsorted Top-10 traders list yet, ***tTraders***

17- When 10 unique users are placed in the unordered Top-10 traders list, check the index and daily volume calculations of the user with the least volume in the list, ***tTraders*** & ***findTLast***

18- When the unsorted Top-10 traders list is filled, check if the current user's daily volume is larger than the user who has the least volume within the Top-10 traders, If no, then check that there is no change in the unordered Top-10 traders list, ***tTraders***

19- When the unsorted Top-10 traders list is not filled and a user who made a transaction during the day makes another transaction:

19-A- Check that the user's volume value is correctly updated, ***tcdetailz***

19-B- Check that the user's volume in the unsorted Top-10 traders list (tTraders) list is correctly updated, ***tTraders***

20- If the current user has more volume than the user with the lowest volume among the Top-10 traders, check that the user's status is correctly determined from the options below:

20-A- If the current user is already in the unsorted Top-10 list, check that the volume of the user in the tTraders list is correctly updated and that there is no other change in the tTraders list, ***tTraders***

20-B- If the current user is not in the unsorted Top-10 list, check that the current trader is placed in the correct index value in the tTraders list with the correct volume, ***tTraders***

20-C- Check that the index and volume values of the user with the least volume in the new list

are calculated correctly after the current trader has been placed in the tTraders list, ***findTLast***

20-D- If the current user is the user with the least volume in the unsorted Top-10 list

20-E- Check that the current user's volume in the tTraders list and in findTlast has been updated correctly if the current user's updated volume value is still less than the 9th ranked user's volume, ***tTraders*** & ***findTLast***

20-F- Check the index and volume values of the user with the lowest volume in the tTraders list if the updated volume value of the last ranked user is greater than the volume of the 9th ranked user, ***tTraders*** & ***findTLast***

21- Check that the unsorted Top-10 traders list is properly sorted, ***sortTraders***

22- Check that the data related to the trading competition resets daily, ***calculateUserTCreward, pendingTCreward, isTraderIn*** & ***dailyRewardForTC***

23- Check the stability of the f*ilter-and-sort* algorithm (checking that the user who previously traded from two users with the same transaction volume is at the top), ***sortTraders***

24- Check that the trading competition rewards can only be claimed by competition winners, ***getTCreward***

25- Check that the trading competition mint rewards are set to zero when the PERA token emission plan expires, ***calculateUserTCreward***

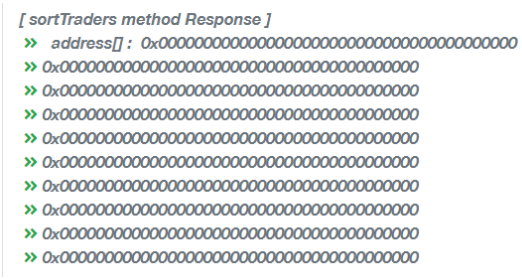
PERA daily trading competition tests were conducted to include each of the checkpoints described above. In each step of testing, data will be given about which user made which type of transaction with how many tokens. (For example, Wallet-2 makes 1000 buys.) After each transaction, the changes in the variables related to the trading competition and the expected values will be compared. In order to speed up the tests, the duration of the competition has been reduced from 28800 blocks (1 day) to 3600 blocks (3 hours). In the list below, you can find the transaction scenario used during the tests. Transactions can be checked from the link below.

https://testnet.bscscan.com/address/0x12133c6e75c834d11ea5f76e59e807cd489e7d58#transactions

User-ID	Wallet-ID
Contract Owner	AbF
Wallet-2	603
Wallet-3	D10
Wallet-4	70f
Wallet-5	055
Wallet-6	2f6
Wallet-7	a92
Wallet-8	7Ff
Wallet-9	319
Wallet-10	958
Wallet-11	F74
Wallet-12	920

	Tx Type	User-ID	Wallet-ID	Tx Amount	Total Volume
1	Buy	Wallet-2	603	1000	1000
2	Buy	Wallet-3	D10	2500	2500
3	Buy	Wallet-4	70f	750	750
4	Buy	Wallet-5	055	1500	1500
5	Sell	Wallet-2	603	750	1750
6	Buy	Wallet-6	2f6	8000	8000
7	Buy	Wallet-7	a92	1250	1250
8	Buy	Wallet-8	7Ff	7500	7500
9	Buy	Wallet-9	319	500	500
10	Buy	Wallet-10	958	1000	1000
11	Buy	Wallet-11	F74	5000	5000
12	Buy	Wallet-12	920	250	250
13	Buy	Wallet-12	920	600	850
14	Buy	Wallet-10	958	1000	2000
15	Buy	Wallet-4	70f	3000	3750
16	Add Liq	Wallet-12	920	200	1050
17	Sell	Wallet-12	920	250	1300
18	Buy	Wallet-11	F74	1000	6000
19	Buy	Wallet-11	F74	4000	10000
20	Buy	Wallet-11	F74	75	10000
21	Buy	Wallet-9	319	10000	10500
22	Transfer	Wallet-10	958	1000	3000
			Total Volume	51125	

There is no user in the Top-10 traders list at the beginning of the day.



Check-11/13/15/16/21- Tx-1

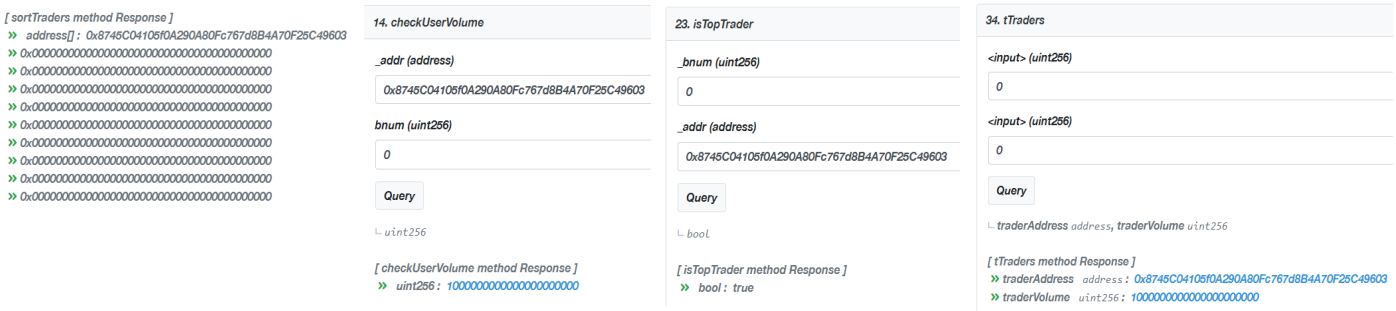
Wallet-2 buys 1000 tokens

https://testnet.bscscan.com/tx/0xbee5d2909f9b46250678b861562a0e52e6154808a189d73de1e4c33e28cd914a

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-2	603	1000
2			
3			
4			
5			
6			
7			
8			
9			
10			

Results



Check-11/13/15/16/21- Tx-2

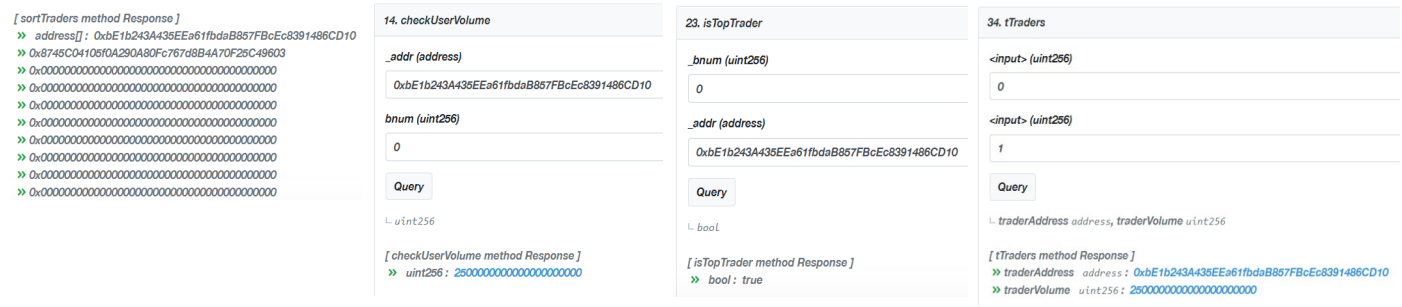
Wallet-3 buys 2500 tokens.

https://testnet.bscscan.com/tx/0x2212d97591fdfb5a8353705b491fdec916d0453b7ffb866b3e0fb0424d559233

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-3	D10	2500
2	Wallet-2	603	1000
3			
4			
5			
6			
7			
8			
9			
10			

Results



Check-11/13/15/16/21- Tx-3

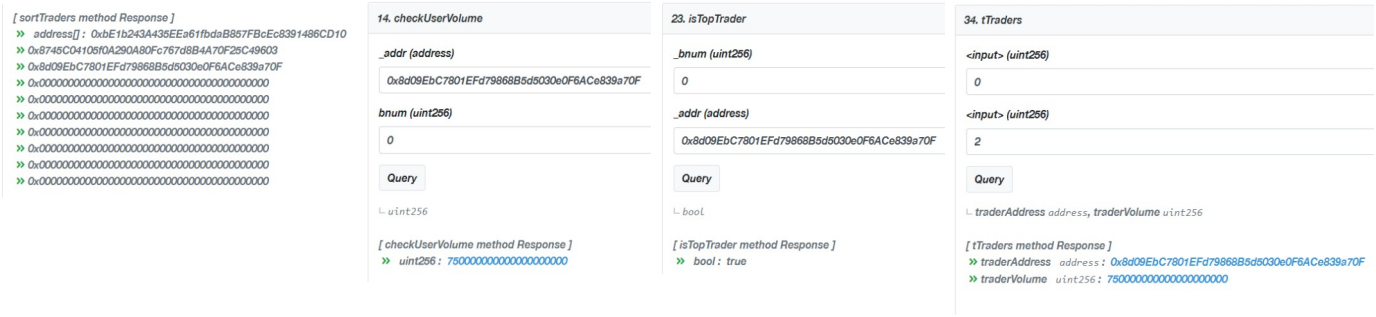
Wallet-4 buys 750 tokens.

https://testnet.bscscan.com/tx/0xbce9f968013b4b594b5ba562d9f2ec7dd243674598a2f426d8a93efa672b3ab9

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-3	D10	2500
2	Wallet-2	603	1000
3	Wallet-4	70f	750
4			
5			
6			
7			
8			
9			
10			

Results



Check-11/13/15/16/21- Tx-4

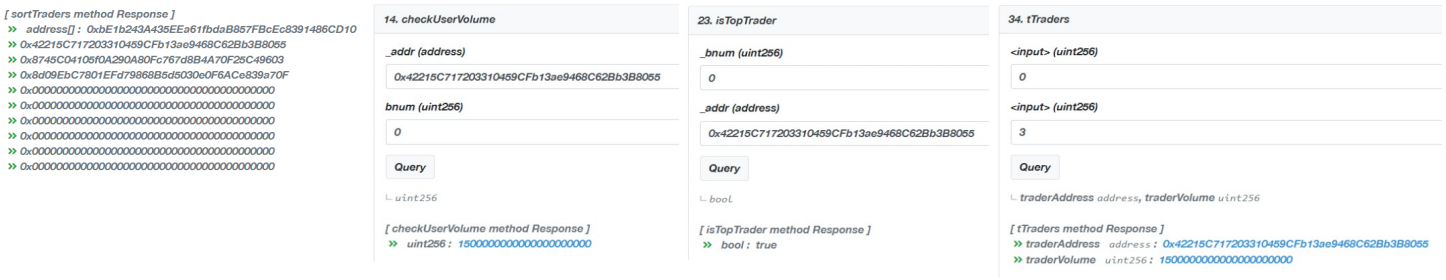
Wallet-5 buys 1500 tokens.

https://testnet.bscscan.com/tx/0xf7d0df8a99c2fee8b3fa0ce4ea3a54aa80cef41e2cbdb7f9efcb00a29b34f381

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-3	D10	2500
2	Wallet-5	055	1500
3	Wallet-2	603	1000
4	Wallet-4	70f	750
5			
6			
7			
8			
9			
10			

Results



Check-5/11/13/15/16/19A/19B/21- Tx-5

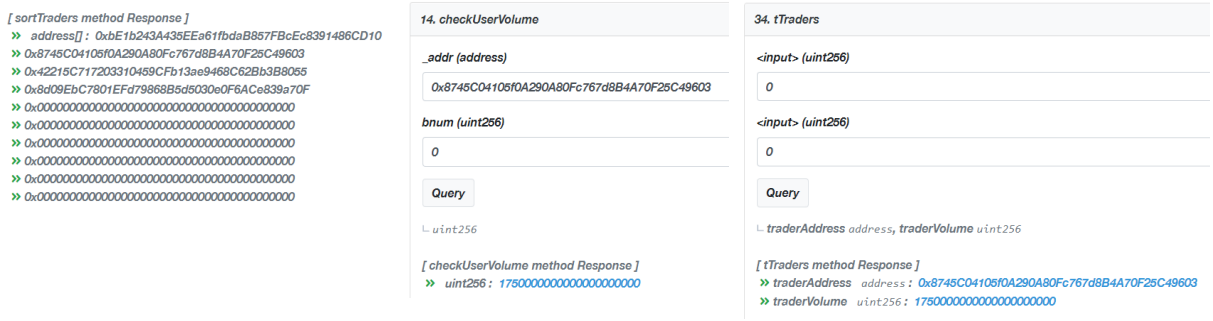
Wallet-2 sells 750 tokens.

https://testnet.bscscan.com/tx/0xf7d0df8a99c2fee8b3fa0ce4ea3a54aa80cef41e2cbdb7f9efcb00a29b34f381

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-3	D10	2500
2	Wallet-2	603	1750
3	Wallet-5	055	1500
4	Wallet-4	70f	750
5			
6			
7			
8			
9			
10			

Results



Check-11/13/15/16/21- Tx-6

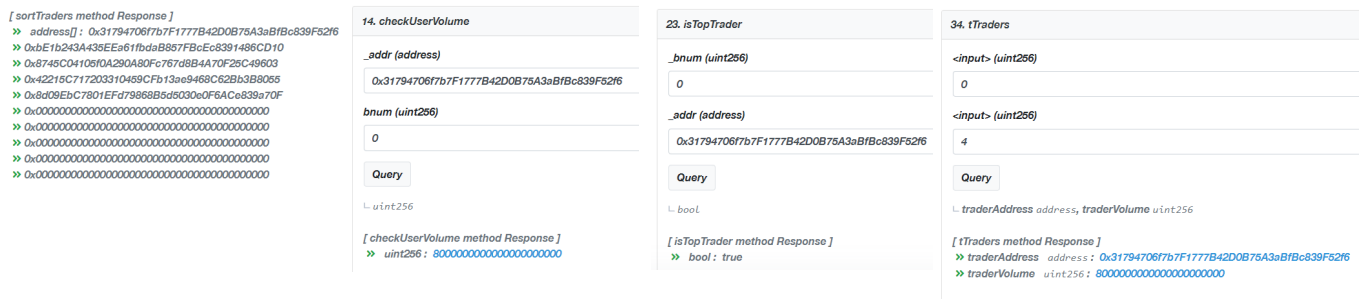
Wallet-6 buys 8000 tokens.

https://testnet.bscscan.com/tx/0xd5f974ccbee8e79986e0dd78b4b5a7f5887846dfd07f6ed9ec86ed1d07b00dc6

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-3	D10	2500
3	Wallet-2	603	1000
4	Wallet-5	055	1500
5	Wallet-4	70f	750
6			
7			
8			
9			
10			

Results



Check-11/13/15/16/21- Tx-7

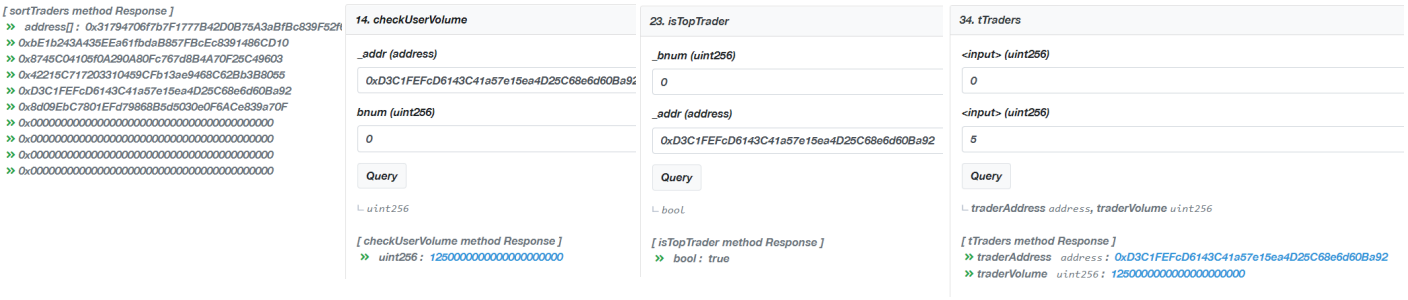
Wallet-7 buys 1250 tokens.

https://testnet.bscscan.com/tx/0x7d0de420d063f069bf6131a8b0050effc3ae4fda7611c192038ad0c5885b4bf1

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-3	D10	2500
3	Wallet-2	603	1000
4	Wallet-5	055	1500
5	Wallet-7	a92	1250
6	Wallet-4	70f	750
7			
8			
9			
10			

Results



Check-11/13/15/16/21- Tx-8

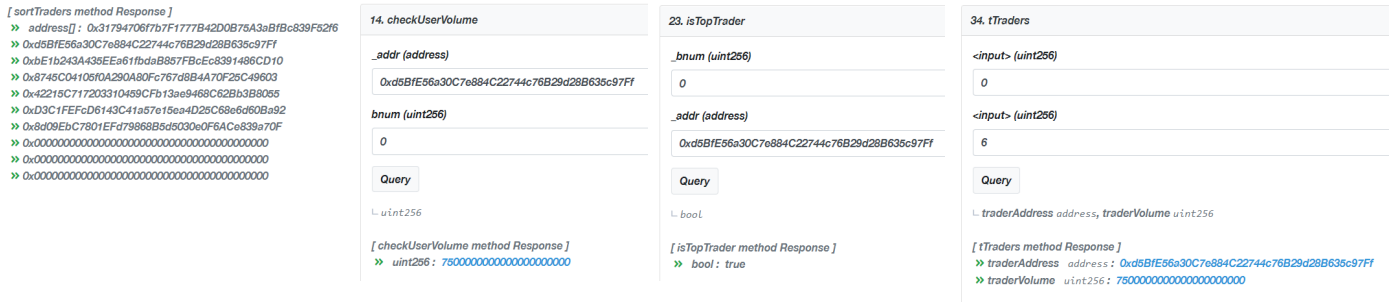
Wallet-8 buys 7500 tokens.

https://testnet.bscscan.com/tx/0x7d0de420d063f069bf6131a8b0050effc3ae4fda7611c192038ad0c5885b4bf1

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-3	D10	2500
4	Wallet-2	603	1000
5	Wallet-5	055	1500
6	Wallet-7	a92	1250
7	Wallet-4	70f	750
8			
9			
10			

Results



Check-11/13/15/16/21- Tx-9

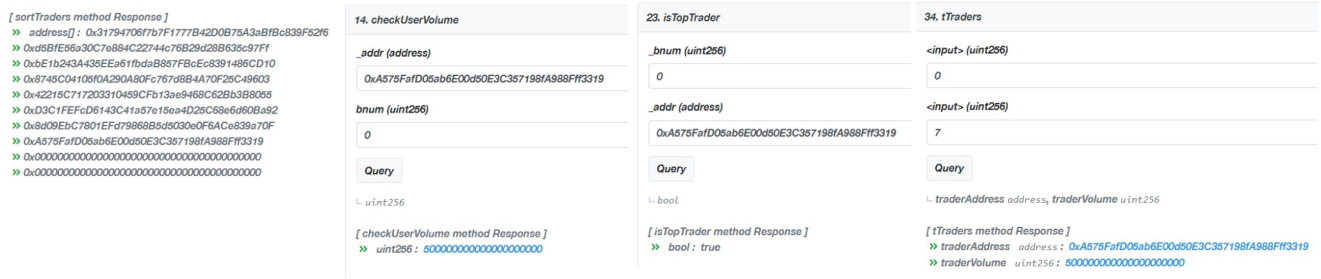
Wallet-9 buys 500 tokens.

https://testnet.bscscan.com/tx/0xfa589d6ce0a692492d88ae4195e0926b5fa38f77e2e220b5eccc9bd4b46fdf70

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-3	D10	2500
4	Wallet-2	603	1000
5	Wallet-5	055	1500
6	Wallet-7	a92	1250
7	Wallet-4	70f	750
8	Wallet-9	319	500
9			
10			

Results



Check-11/13/15/16/21- Tx-10

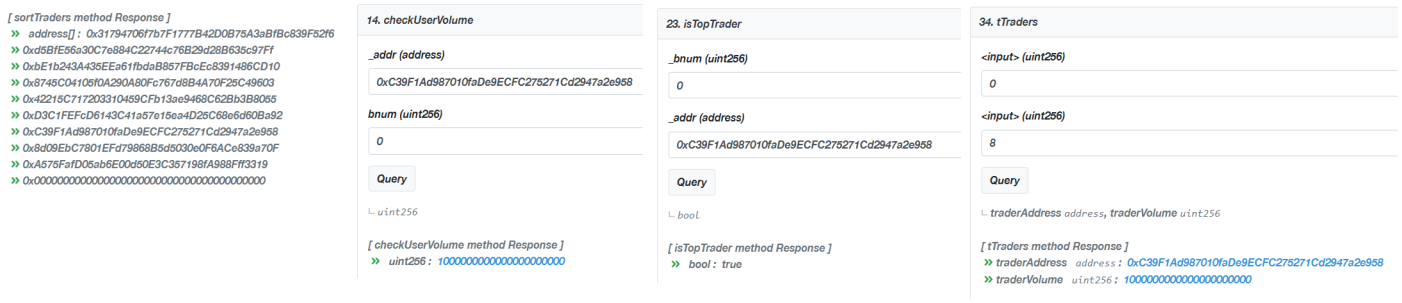
Wallet-10 buys 1000 tokens.

https://testnet.bscscan.com/tx/0xb079b67555b2b782ae2929fc0393a195f19ef957223177d63a48d1b4cca69e75

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-3	D10	2500
4	Wallet-2	603	1000
5	Wallet-5	055	1500
6	Wallet-7	a92	1250
7	Wallet-10	958	1000
8	Wallet-4	70f	750
9	Wallet-9	319	500
10			

Results



Check-11/13/15/16/21- Tx-11

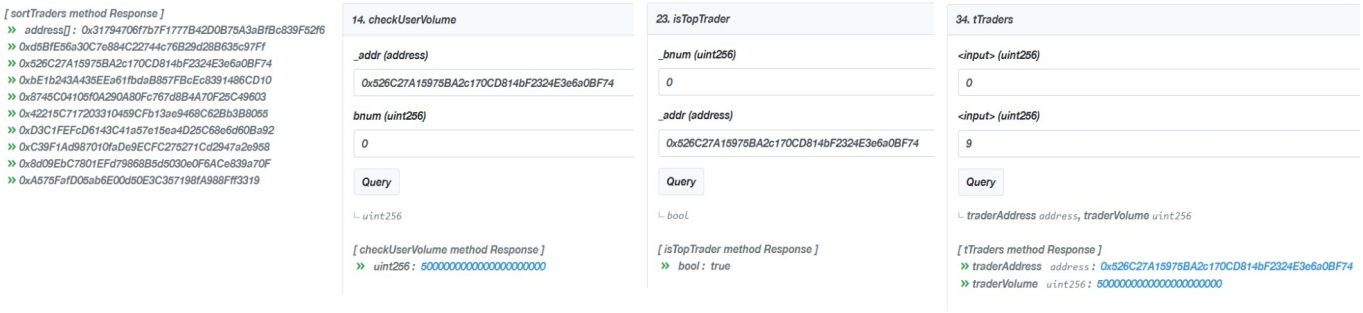
Wallet-11 buys 5000 tokens.

https://testnet.bscscan.com/tx/0x590d1896cd867e31d3cc39ad6955621f716331bb3611d98bd189a2e7037df563

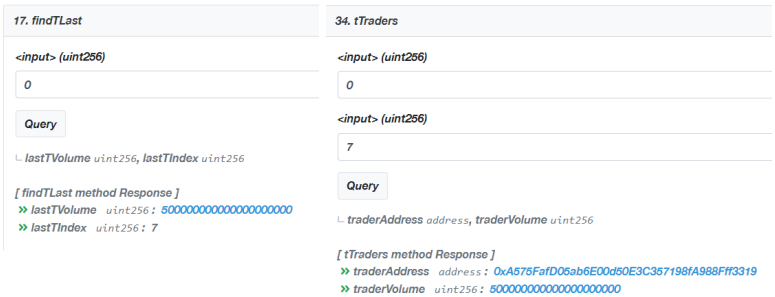
Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-11	F74	5000
4	Wallet-3	D10	2500
5	Wallet-2	603	1750
6	Wallet-5	055	1500
7	Wallet-7	a92	1250
8	Wallet-10	958	1000
9	Wallet-4	70f	750
10	Wallet-9	319	500

Results



Check-12/21- Last Place Check



Check-11/13/15/18/21- Tx-12

Wallet-12 buys 250 tokens.

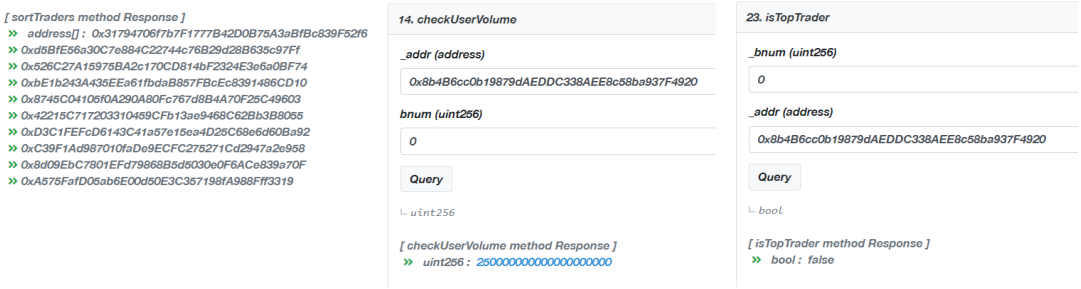
https://testnet.bscscan.com/tx/0x590d1896cd867e31d3cc39ad6955621f716331bb3611d98bd189a2e7037df563

Expected

There should be no change in the Top-10 list.

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-11	F74	5000
4	Wallet-3	D10	2500
5	Wallet-2	603	1750
6	Wallet-5	055	1500
7	Wallet-7	a92	1250
8	Wallet-10	958	1000
9	Wallet-4	70f	750
10	Wallet-9	319	500

Results



Tx-11/12/13/15/21

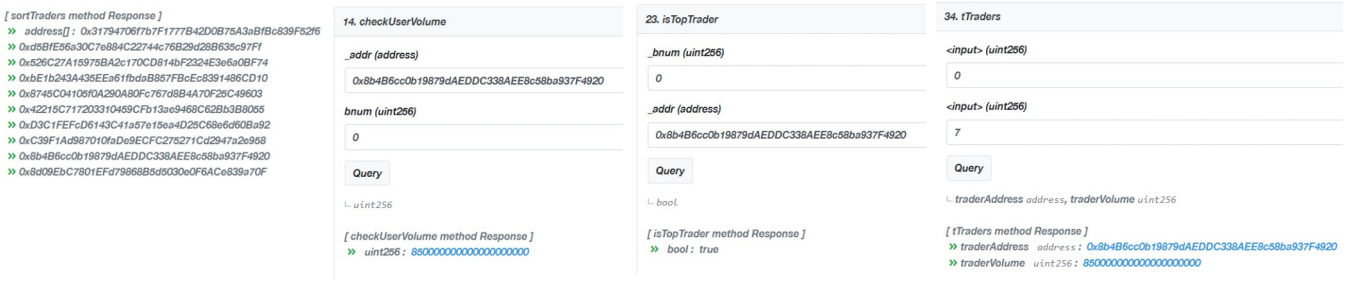
Wallet-12 buys 600 tokens.

https://testnet.bscscan.com/tx/0x1498ac46d1d77903fcdde6e53a313306e52608edfa39a1934f44a9f523e6bca8

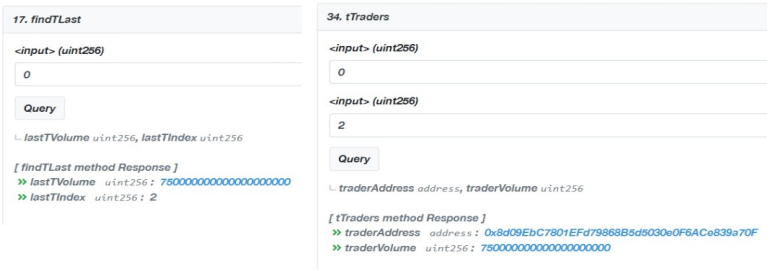
Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-11	F74	5000
4	Wallet-3	D10	2500
5	Wallet-2	603	1750
6	Wallet-5	055	1500
7	Wallet-7	a92	1250
8	Wallet-10	958	1000
9	Wallet-12	920	850
10	Wallet-4	70f	750

Results



Check-12- Last Place Check



11/13/15/21 Tx-14

Wallet-10 buys 1000 tokens.

https://testnet.bscscan.com/tx/0xd6f97443dc812feeaa51445f8b9399bf540b8eaaf7b3ad03322b979bd64602dc

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-11	F74	5000
4	Wallet-3	D10	2500
5	Wallet-10	958	2000
6	Wallet-2	603	1750
7	Wallet-5	055	1500
8	Wallet-7	a92	1250
9	Wallet-12	920	850
10	Wallet-4	70f	750

Results

Check-20D/20F- Tx-15

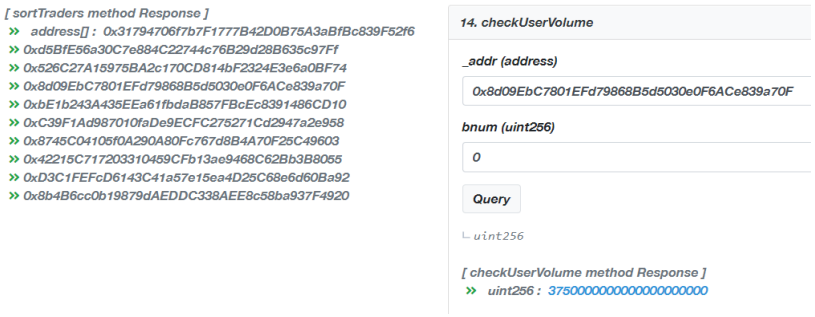
Wallet-4 buys 3000 tokens.

https://testnet.bscscan.com/tx/0xb1432e7681b65f53b3abb107ad33aba4f95b41fcb82317808bb253d9d9ca0963

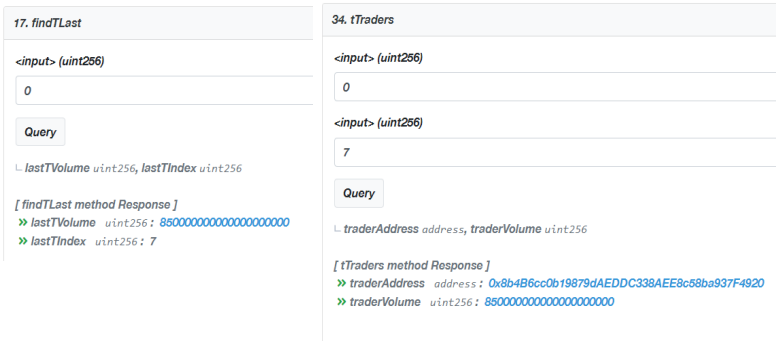
Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-11	F74	5000
4	Wallet-4	70f	3750
5	Wallet-3	D10	2500
6	Wallet-10	958	2000
7	Wallet-2	603	1750
8	Wallet-5	055	1500
9	Wallet-7	a92	1250
10	Wallet-12	920	850

Results



Check-12- Last Place Check



Check-20D/20E- Tx-16

Wallet-12 adds liquidity to BakerySwap testnet pool with 200 tokens.

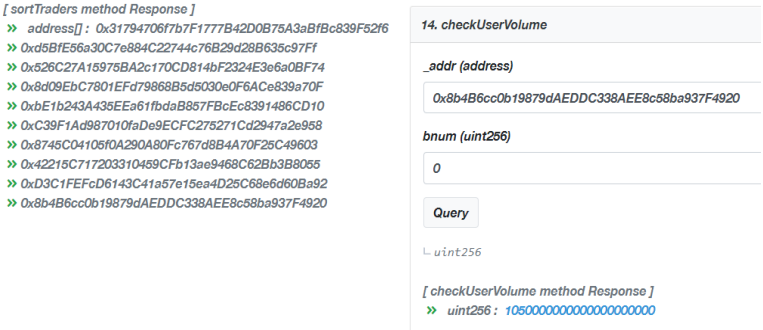
https://testnet.bscscan.com/tx/0x02c09c5b26f4bcb783a5da280f875351b9cc47eff815f72332bc7b1b3fb90cbd

Expected

There should be no change in the Top-10 list except the volume of Wallet-12.

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-11	F74	5000
4	Wallet-4	70f	3750
5	Wallet-3	D10	2500
6	Wallet-10	958	2000
7	Wallet-2	603	1750
8	Wallet-5	055	1500
9	Wallet-7	a92	1250
10	Wallet-12	920	1050

Results



Tx-17

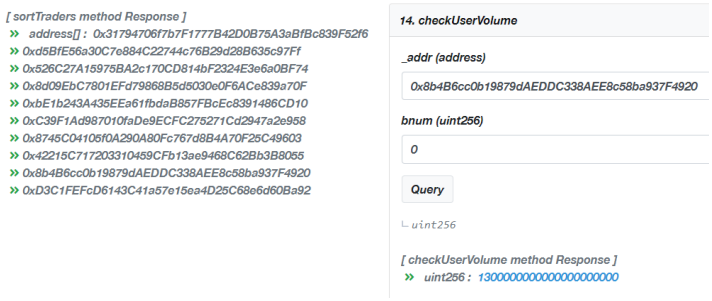
Wallet-12 sells 250 tokens.

https://testnet.bscscan.com/tx/0xaada3da42c32c6f86a4e211395c9856743b41b0002c0e565c58f9e4f3ea8ef32

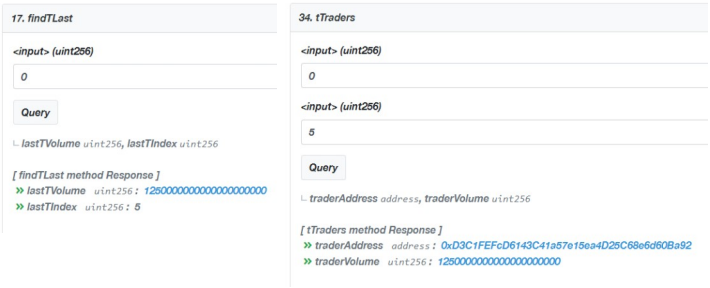
Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-11	F74	5000
4	Wallet-4	70f	3750
5	Wallet-3	D10	2500
6	Wallet-10	958	2000
7	Wallet-2	603	1750
8	Wallet-5	055	1500
9	Wallet-12	920	1300
10	Wallet-7	a92	1250

Results



Check-12- Last Place Check



11/13/15/21- Tx-18

Wallet-11 buys 1000 tokens.

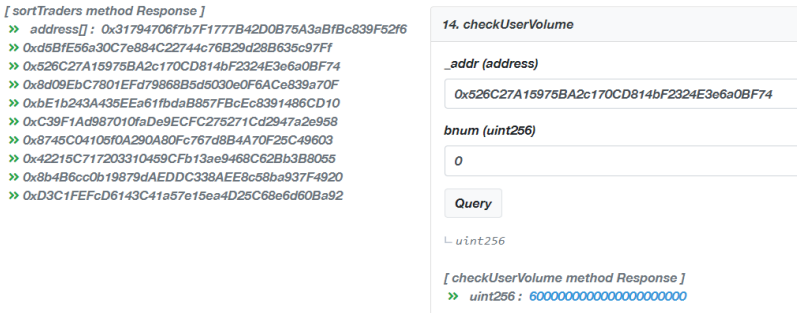
https://testnet.bscscan.com/tx/0xaada3da42c32c6f86a4e211395c9856743b41b0002c0e565c58f9e4f3ea8ef32

Expected

There should be no change in the Top-10 list except the volume of Wallet-11.

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-6	2f6	8000
2	Wallet-8	7Ff	7500
3	Wallet-11	F74	6000
4	Wallet-4	70f	3750
5	Wallet-3	D10	2500
6	Wallet-10	958	2000
7	Wallet-2	603	1750
8	Wallet-5	055	1500
9	Wallet-12	920	1300
10	Wallet-7	a92	1250

Results



11/13/15/21- Tx-19

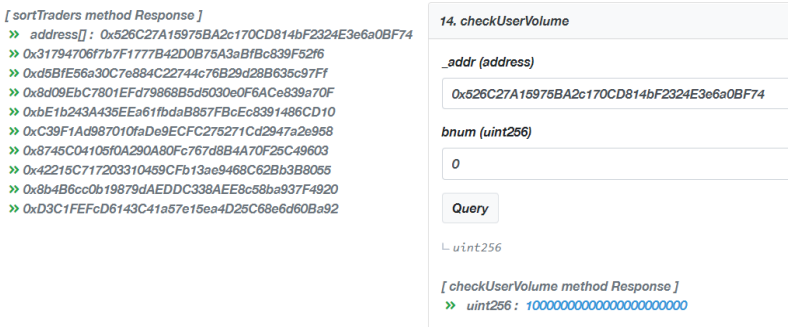
Wallet-11 buys 4000 tokens.

https://testnet.bscscan.com/tx/0x5c8253ac151310995a55302bc22571981528311522a387aafb522cfcf49041bf

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-11	F74	10000
2	Wallet-6	2f6	8000
3	Wallet-8	7Ff	7500
4	Wallet-4	70f	3750
5	Wallet-3	D10	2500
6	Wallet-10	958	2000
7	Wallet-2	603	1750
8	Wallet-5	055	1500
9	Wallet-12	920	1300
10	Wallet-7	a92	1250

Results



Check-5- Tx-20

Wallet-11 buys 75 tokens.

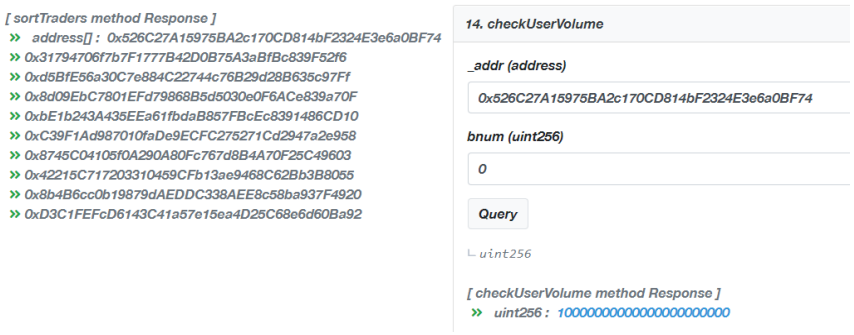
https://testnet.bscscan.com/tx/0xeed7afa4e45b16c8e827273e0d7b446c1cf2b22bd8f0685e6060a4a03fd45d76

Expected

Minimum transaction amount required for the trading competition is set to 100 tokens. After the transaction, neither the volume of Wallet-11 nor Top-10 traders list should change.

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-11	F74	10000
2	Wallet-6	2f6	8000
3	Wallet-8	7Ff	7500
4	Wallet-4	70f	3750
5	Wallet-3	D10	2500
6	Wallet-10	958	2000
7	Wallet-2	603	1750
8	Wallet-5	055	1500
9	Wallet-12	920	1300
10	Wallet-7	a92	1250

Results



Check-20B/20C- Tx-21

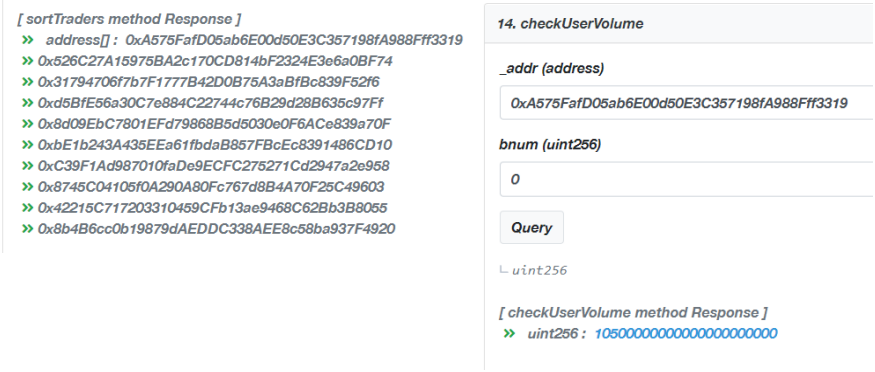
Wallet-9 buys 10000 tokens.

https://testnet.bscscan.com/tx/0x4f84bd17c927efecec90744ed990d9c077e61e9d43477f9bef51cc5f06102c7c

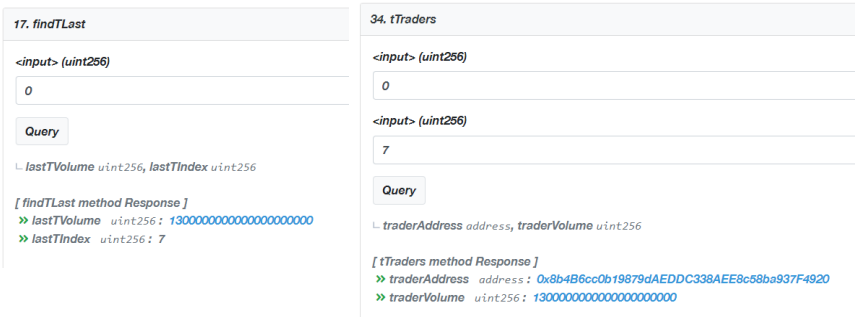
Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-9	319	10500
2	Wallet-11	F74	10000
3	Wallet-6	2f6	8000
4	Wallet-8	7Ff	7500
5	Wallet-4	70f	3750
6	Wallet-3	D10	2500
7	Wallet-10	958	2000
8	Wallet-2	603	1750
9	Wallet-5	055	1500
10	Wallet-12	920	1300

Results



Check-12- Last Place Check



Check-20A- Tx-22

Wallet-10 transfers 1000 tokens.

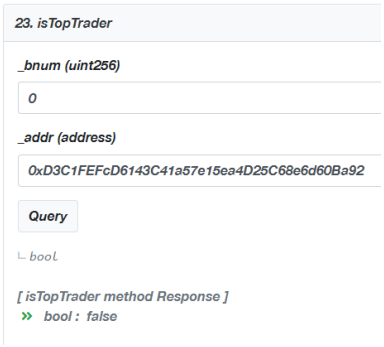
https://testnet.bscscan.com/tx/0x55120170de3e8e96b4cbee0e1946d0eee80c8631c02e39a012794b949fafa35b

Expected

Rankings	User-ID	Wallet-ID	Volume
1	Wallet-9	319	10500
2	Wallet-11	F74	10000
3	Wallet-6	2f6	8000
4	Wallet-8	7Ff	7500
5	Wallet-4	70f	3750
6	Wallet-10	958	3000
7	Wallet-3	D10	2500
8	Wallet-2	603	1750
9	Wallet-5	055	1500
10	Wallet-12	920	1300

Results

Previous Last Place, isTopTrader, Check



Check-1/2/3/6/7 - *Reward Claim*

Competition winner Wallet-9 claims trading competition rewards right after the next day. Users who claim the competition rewards the other day that they won the competition can claim 51% of their total rewards. While a daily 5600 token mint reward is created for the trading competition rewards, a share of 0.5% of each transaction is also collected in the competition prize pool. Considering that the winner of the competition can claim 19% of the total rewards in the pool, the rewards that Wallet-9 can claim can be calculated as follows.

Total amount of transactions made during the day = 51125 Tokens
Trading competition fee rewards for the day = 0.005 * 51125 = 255.625 Tokens
Trading competition total rewards for the day = 5600 + 255.625 = 5855.625 Tokens
Wallet-9 rewards = 0.19 * 0.51 * 5997.25 = 567.4100625 Tokens

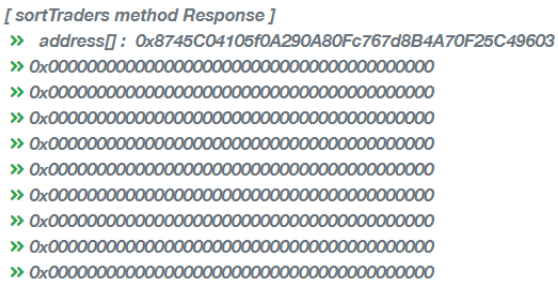
- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.
https://testnet.bscscan.com/tx/0x59a38190e4cfa81959ce23efa27b49c9f6eba0f426cc62badaf8ae832cadf64a

Check-9- *Multiple Reward Claim*

Transaction failed when Wallet-9 tried to claim the trading competition rewards for the same day again.
https://testnet.bscscan.com/tx/0x960a23db4d933c6f9fc55b2b9782959e2c58a40364d4313d8d5971a7b794fc44

Check-4- *Trading Competition Mint Reward Multiplier*

The trading competition time for the next test has been reduced to 10 minutes.
https://testnet.bscscan.com/token/0x313fe40b89e1fb33151e33a7a5852f6cadffdf2e
The trading competition mint reward coefficient has been increased from 20 to 40 by the contract owner, corresponding to a total of 11,200 mint rewards during the competition period.
https://testnet.bscscan.com/tx/0xd5fdef62637b040b773e82706374c5fd072f755f5f11d2be803e6c39c327575e



According to the new coefficient, the competition rewards that the user can claim can be calculated as follows.

User's Total Rewards = 0.19 * 0.51 * 11200

= 1,085.28 Tokens

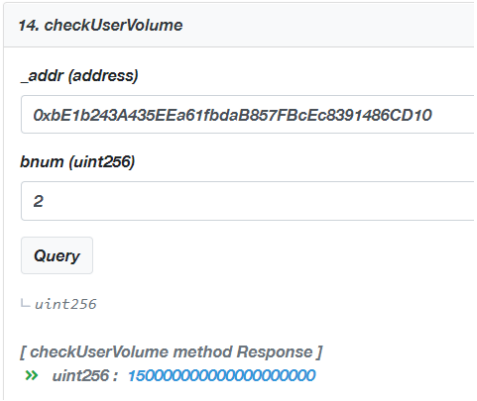
- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0x1b27851b72c3fe2b533163ede9c59686bde6e4bd3fd3e7a5cdd238f54b16efe3

Check-8 – *Minimum Required Transaction Amount for the Trading Competition*

While the minimum participation requirement for the trading competition was 100 tokens, the daily volume value of the Wallet-3 was checked after the user transferred 150 tokens.

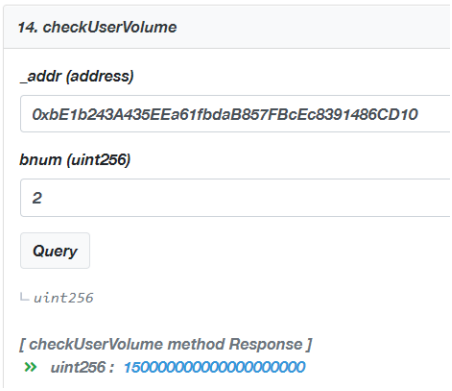
https://testnet.bscscan.com/tx/0x80cebe5a3a956931692c05419a0b9c1ccb594fe73445d63df5a68e33bb4bbb34



- In the next transaction, the contract owner updated the minimum contribution amount to 250 tokens.

https://testnet.bscscan.com/tx/0x1043704f227320addd902f7c829857f408e2227a2e2bee2f52ea402ff1a98e92

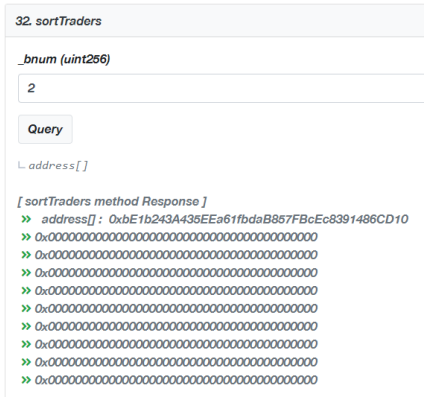
- After transferring 150 tokens again with Wallet-3, the daily volume of the user was checked and there was no change in the volume data.



Check-14- *Excluded Accounts can not Participate in the Trading Competition*

On the same day, a transaction was made with the contract owner and the owner was not included in the trading competition list.

https://testnet.bscscan.com/tx/0xc21b6cae2b1bce842b2e8e2e22f222b8ee945672dc6c8a4451118b0d2094ec24



Check-24 – *Claim reward with a User who does not Participate in the Trading Competition*

When Wallet-2 tried to claim the competition rewards for the 3rd day, although it was not included in the competition on the 3rd day, it was checked whether a reward was sent to the user.

https://testnet.bscscan.com/tx/0xd9f66bbe3930f25ea1440311484ba53950f7106a260b80b8e84bdd21c66c6709

Check-25- *Trading Competition Daily Reset of Variables*

From the link given below, you can check that the trading competition is reset every 3 hours since the contract creation. The number of days can be checked by using the *showbnum* read function in the smart contract. Users can check the trading competition related variables of the day they make transactions by using the BakerySwap testnet pool.

https://testnet.bscscan.com/token/0x12133c6e75c834d11ea5f76e59e807cd489e7d58

Check-23- *Stability of the Sorting Algorithm*

Stable sorting algorithms maintain the relative order of records with equal keys (i.e. user volumes). That is, a sorting algorithm is stable if whenever there are two records R and S with the same key and with R appearing before S in the original list, R will appear before S in the sorted list.

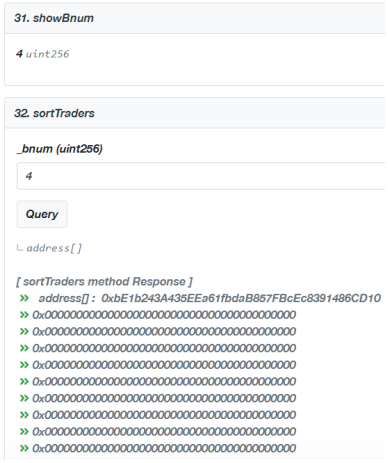
In order to test the stability of the algorithm, 2 different users have made transfers with 1000 tokens and it was checked whether the user who made the early transaction was at the top of the ranking.

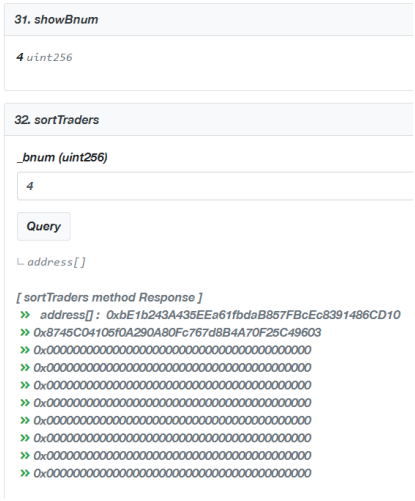
Tx-1 (Wallet-ID = D10)

https://testnet.bscscan.com/tx/0x1108aec064655f0b2184f7d22919c587a2d14a1246b5817962ef2dd7bdb29413

Tx-2 (Wallet-ID = 603)

https://testnet.bscscan.com/tx/0x645c0ed6b4ab81dc921b7e66e63d10a8c609b1b7df9a08895ebfa403150e5c60





TRANSFER FUNCTION AND HOLDER REWARD DISTRIBUTION TESTS

The following points regarding the transfer requirements have been checked.

- Check that the balance checks on the account making the transaction are made correctly

---

```
if(!_isExcluded(_from)){
        require(userbalanceOf[_from].div(transferRate) >= _value);
        require(userbalanceOf[_to].div(transferRate) + _value >= userbalanceOf[_to].div(transferRate));
}else{
        require(userbalanceOf[_from] >= _value);
        require(userbalanceOf[_to] + _value >= userbalanceOf[_to]);
}
```

- Check the balance change of the transaction receiver according to whether the account to which the transaction is sent is an excluded account or a holder.

```
if ((_isExcluded(_to)) && (_isExcluded(_from))){
        userbalanceOf[_from] -= _value;
        userbalanceOf[_to] +=   (_value).sub(totalOut);
} else if(_isExcluded(_to)){
        userbalanceOf[_from] -= _value.mul(transferRate);
        userbalanceOf[_to] +=   (_value).sub(totalOut);
} else if (_isExcluded(_from)){
        userbalanceOf[_from] -= _value;
        uint transferAmount = (_value).sub(totalOut);
        userbalanceOf[_to] +=  transferAmount.mul(transferRate);
} else{
        userbalanceOf[_from] -= _value.mul(transferRate);
        uint transferAmount = (_value).sub(totalOut);
        userbalanceOf[_to] +=   transferAmount.mul(transferRate);
}
```

0.75% transaction fee is taken from the transactions made by each user who is not tagged as *nonTaxable*, and is instantly reflected in the holder balances in proportion to the number of tokens they hold. In order to test the distribution mechanism of holder rewards, a scenario as below was followed. Balances of BurgerSwap testnet pool, contract owner and PERA holding users were checked after each transaction.

	Rate Initial	1								
	Total Fee	2.00%	10,000,000							
Transaction	Holder Fee	0.75%	Contract Deployer	BurgerSwap	Wallet-2	Wallet-3	Wallet-4	Wallet-5	Wallet-6	
https://testnet.bscscan.com/tx/0	Tx Amount	0.00000000001	6,000,000	4,000,000	0.00000000000980					Included Supply
Buy-2	Fee	0			0.9924					0.000000000009875
		0			**0.000000000009875**					
https://testnet.bscscan.com/tx/0	Tx Amount	1,000	6,000,000	3,999,000	973					Included Supply
Buy-2	Fee	20			0.9849					988
		8			**987.5000**					
https://testnet.bscscan.com/tx/0	Tx Amount	2,444.4	6,000,000	3,996,555.6	973	2,359.2627				Included Supply
Buy-3	Fee	49			0.9796	0.9796				3,401.35
		18			**992.851396181874**	**2,408.49360381814**				
https://testnet.bscscan.com/tx/0	Tx Amount	5,120.0	6,000,000	3,991,435.6	973	2,359	4,915.0375			Included Supply
Buy-4	Fee	102			0.9751	0.9751	0.9751			8,457.35
		38			**997.379931956058**	**2,419.47908411129**	**5,040.48598393267**			
https://testnet.bscscan.com/tx/0	Tx Amount	1,111.0	6,000,000	3,990,324.6	973	2,359	4,915.037468	1,061.6822		Included Supply
Buy-5	Fee	22			0.9743	0.9743	0.9743	0.9743		9,554.458
		8			998.25051224733	2,421.59096819707	5,044.88565913712	1,089.73036041849		
https://testnet.bscscan.com/tx/0	Tx Amount	555	6,000,000	3,990,324.6	432	2,359.2627	4,915.0375	1,061.6822	529.9008	Included Supply
Transfer 2-6	Fee	11			0.9738	0.9738	0.9738	0.9738	0.9738	9,548
		4			443.443843604479	2,422.64718687117	5,047.08607304346	1,090.20566511343	544.137231367472	
https://testnet.bscscan.com/tx/0	Tx Amount	545.65891950	6,000,000	3,990,324.6000	431.8418737	2,359.2627	5,446.4201	1,061.6822	529.9008	Included Supply
Claim TC – 4	Fee	0.0000			0.9738	0.9738	0.9738	0.9738	0.9738	10,093
		0.0000			443.443843604479	2,422.64718687117	5,592.74499254346	1,090.205665113	544.137231367	
https://testnet.bscscan.com/tx/0	Tx Amount	2,500	6,000,000	3,992,774.6	432	2,359.2627	3,011.8285	1,061.6822	529.9008	Included Supply
Sell-4	Fee	50			0.9714	0.9714	0.9714	0.9714	0.9714	7,612
		19			444.538849023913	2,428.62948166962	3,100.38197426415	1,092.89773340757	545.480881134757	
https://testnet.bscscan.com/tx/0	Tx Amount	750	6,000,000	3,993,509.6	432	2,359.2627	3,011.8285	333.1038	529.9008	Included Supply
Add Liq-5	Fee	15			0.9706	0.9706	0.9706	0.9706	0.9706	6,868
		6			444.903255454684	2,430.62032724593	3,102.92348246248	343.17882051486	545.928033822052	

- Check whether the accounts excluded have received holder reward or not
- Check whether transaction fees are received from the transactions of accounts tagged as nonTaxable
- Check the balances of each user holding PERA after each transaction and compare the balances with the theoretical calculations
- Check that the minted tokens do not cause a problem on the holder reward distribution mechanism (minted tokens via claiming trading competition rewards or withdrawing LP tokens)
- The steps specified in PERA Smart Contract Deployment Guide were followed in determining the accounts to be excluded. The contract owner, the BurgerSwap testnet pool where the initial liquidity is provided, the BurgerSwap router contract address, and the deployed token's contract addresses are excluded. The contract owner and token contract address are also tagged as *nonTaxable* accounts.

- The contract owner provides 4M of the 10M tokens it holds as the initial liquidity to the BurgerSwap testnet pool.
https://testnet.bscscan.com/tx/0x238f078ed04f113889173889e3cb01e9a2e40ead936b65df7226a0597502a0ef

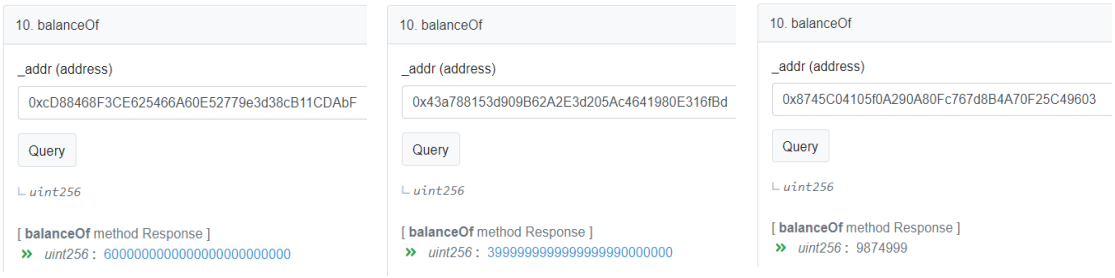
- After the liquidity is added, the first holder transaction is made by Wallet-2 with 0.00000000001 tokens.

https://testnet.bscscan.com/tx/0x05c9fadf001448f6fc3ed526e0d50f784c1b2caca594b1f8cb376b756e04daa2

Expected

	Rate Initial	1								
	Total Fee	2.00%	10,000,000							
Transaction	Holder Fee	0.75%	Contract Deployer	BurgerSwap	Wallet-2	Wallet-3	Wallet-4	Wallet-5	Wallet-6	
https://testnet.bscscan.com/tx/0	Tx Amount	0.00000000001	6,000,000	4,000,000	0.00000000000980					Included Supply
Buy-2	Fee	0			0.9924					0.000000000009875
		0			**0.000000000009875**					

Results



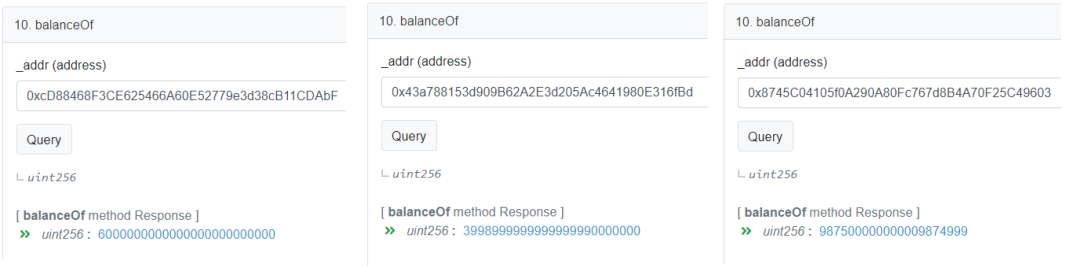
- In the next transaction, Wallet-2 buys 1000 more tokens.

https://testnet.bscscan.com/tx/0xdded86aec3a1ffb10a9ce63678ad88c70528adfd1079717b36d3d42d2c93fa56

Expected

https://testnet.bscscan.com/tx/0	Tx Amount	1,000	6,000,000	3,999,000	973	Included Supply
Buy-2	Fee	20			0.9849	988
		8			**987.5000**	

Results



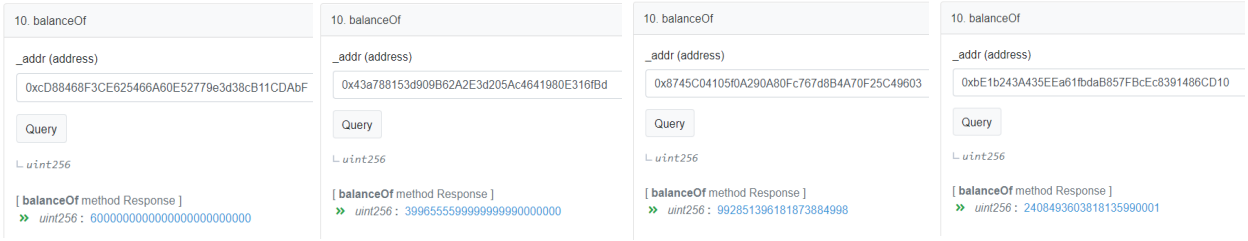
- In the next transaction, Wallet-3 buys 2444.4 tokens.

https://testnet.bscscan.com/tx/0x27ee72b068091b463aa624c966dec85772e5947921f6cb9164dd5d9499eda4a5

Expected

https://testnet.bscscan.com/tx/0	Tx Amount	2,444.4	6,000,000	3,996,555.6	973	2,359.2627	Included Supply
Buy-3	Fee	49			0.9796	0.9796	3,401.35
		18			**992.851396181874**	**2,408.49360381814**	

Results



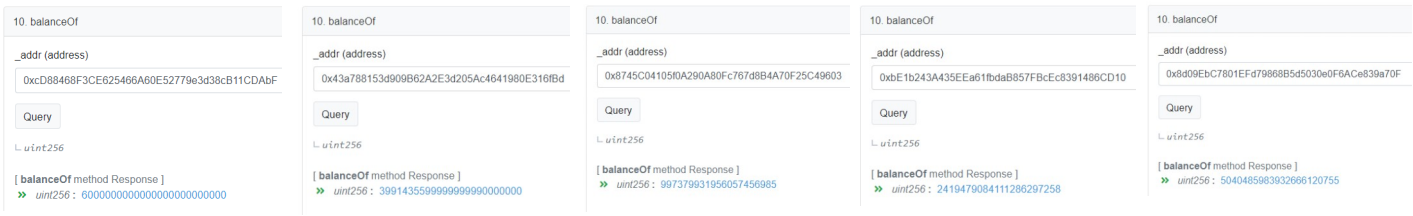
- In the next transaction, Wallet-4 buys 5120 tokens.

https://testnet.bscscan.com/tx/0xaa0381ae1f36ccee17ba267d89603f1f8500b6789aa3b050032ee63ee28b6e32

Expected

https://testnet.bscscan.com/tx/0	**Tx Amount**	5,120.0	6,000,000	3,991,435.6	973	2,359	4,915.0375		**Included Supply**
Buy-4	**Fee**	102			0.9751	0.9751	0.9751		8,457.35
		38			**997.379931956057**	**2,419.47908411129**	**5,040.48598393267**		

Results



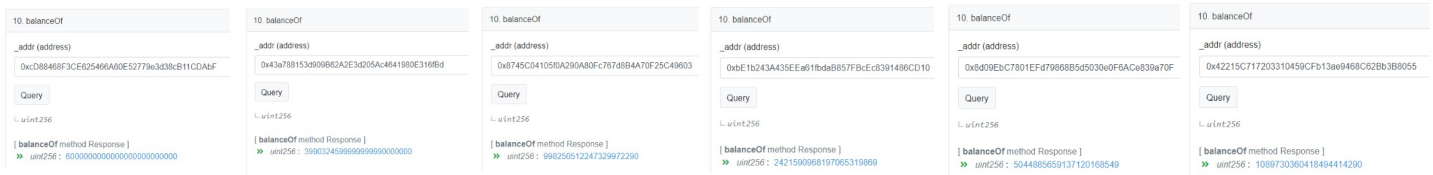
- In the next transaction, Wallet-5 buys 1111 tokens.

https://testnet.bscscan.com/tx/0xb436d570adea6927536dd43b69c89bb8f8df984ed8c09f433501cd11791bc5fa

Expected

https://testnet.bscscan.com/tx/0	**Tx Amount**	1,111.0	6,000,000	3,990,324.6	973	2,359	4,915.037468	1,061.6822	**Included Supply**
Buy-5	**Fee**	22			0.9743	0.9743	0.9743	0.9743	9,554.458
		8			998.25051224733	2,421.59096819707	5,044.88565913713	1,089.73036041850	

Results



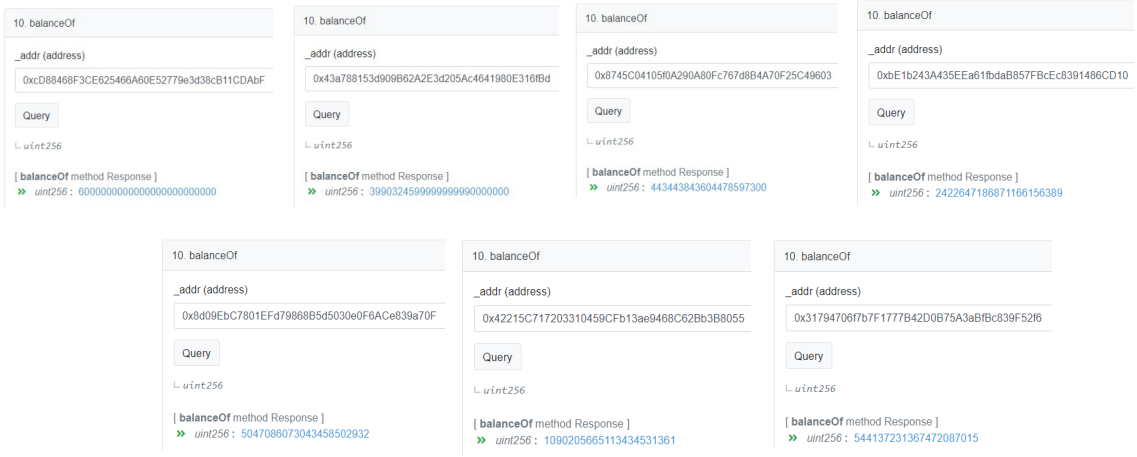
- In the next transaction, Wallet-2 transfers 555 tokens to Wallet-6.

https://testnet.bscscan.com/tx/0x4bbcc22a868674d45d084ce9f4e5302408f631413bff0971419726896219cabe

Expected

https://testnet.bscscan.com/tx/0	**Tx Amount**	555	6,000,000	3,990,324.6	432	2,359.2627	4,915.0375	1,061.6822	529.9008	**Included Supply**
Transfer 2-6	**Fee**	11			0.9738	0.9738	0.9738	0.9738	0.9738	9,548
		4			443.443843604478	2,422.64718687117	5,047.08607304346	1,090.20566511343	544.137231367472	

Results



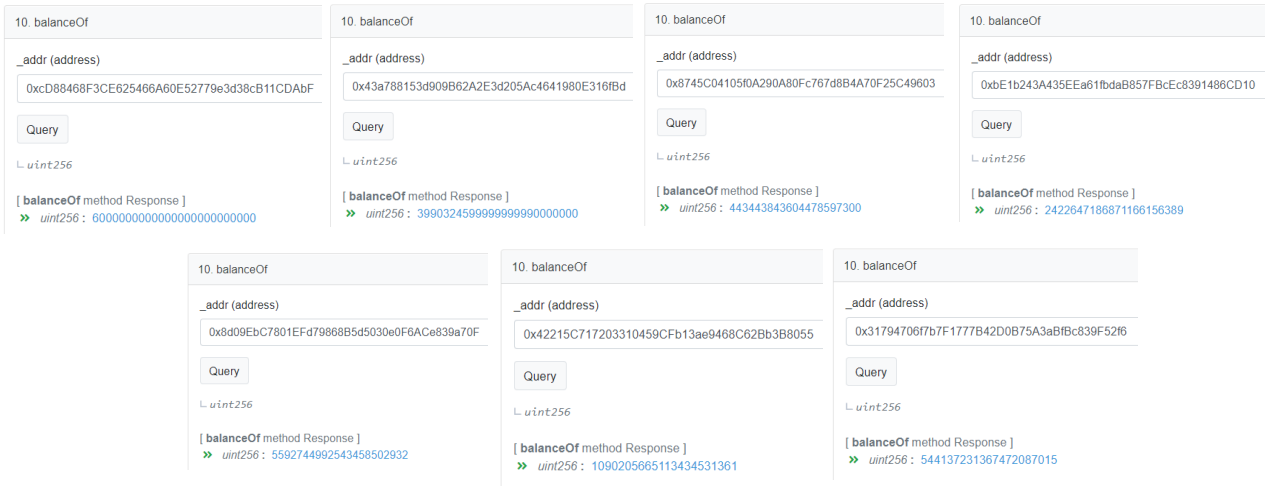
- In the next transaction, Wallet-4 claims its trading competition rewards and receives 545.6589195 tokens.

https://testnet.bscscan.com/tx/0x173c95c8c337438d573a35bce86b98404d17cb401cf045ab92ab2f2960af582c

Expected

https://testnet.bscscan.com/tx/0	**Tx Amount**	545.65891950	6,000,000	3,990,324.6000	431.8418737	2,359.2627	5,446.4201	1,061.6822	529.9008	**Included Supply**
Claim TC – 4	**Fee**	0.0000			0.9738	0.9738	0.9738	0.9738	0.9738	10,093
		0.0000			443.443843604478	2,422.64718687117	5,592.74499254346	1,090.205665113	544.137231367	

Results



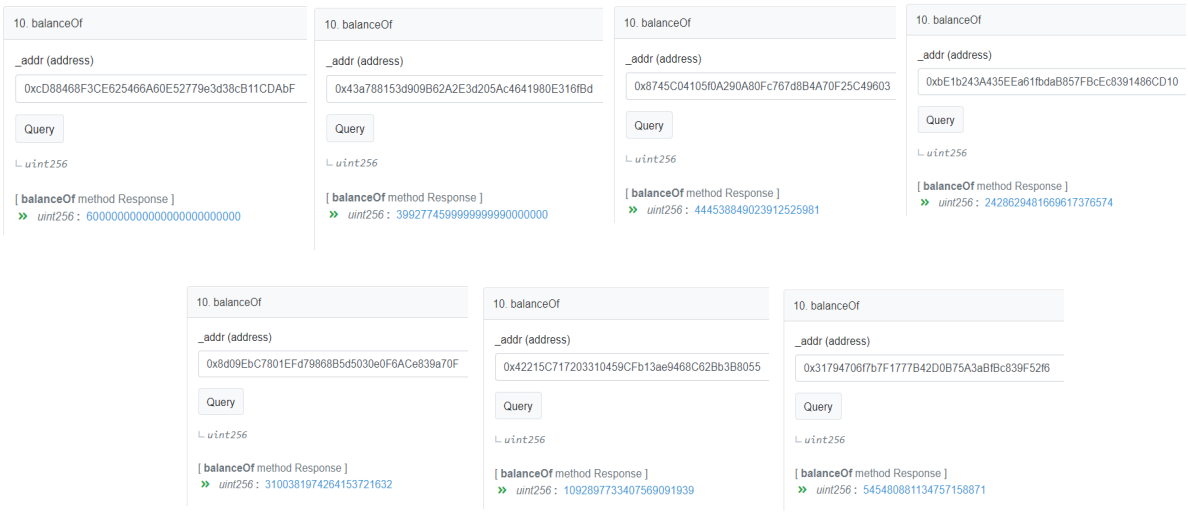
- In the next transaction, Wallet-4 sells 2500 tokens.

https://testnet.bscscan.com/tx/0xa4bbf885549fcb0cd0c5186e10e8367db66ec9a417609434ca6b304206afc13f

Expected

https://testnet.bscscan.com/tx/0	**Tx Amount**	2,500	6,000,000	3,992,774.6	432	2,359.2627	3,011.8285	1,061.6822	529.9008	**Included Supply**
Sell-4	**Fee**	50			0.9714	0.9714	0.9714	0.9714	0.9714	7,612
		19			444.538849023912	2,428.62948166962	3,100.38197426416	1,092.89773340757	545.480881134757	

Results



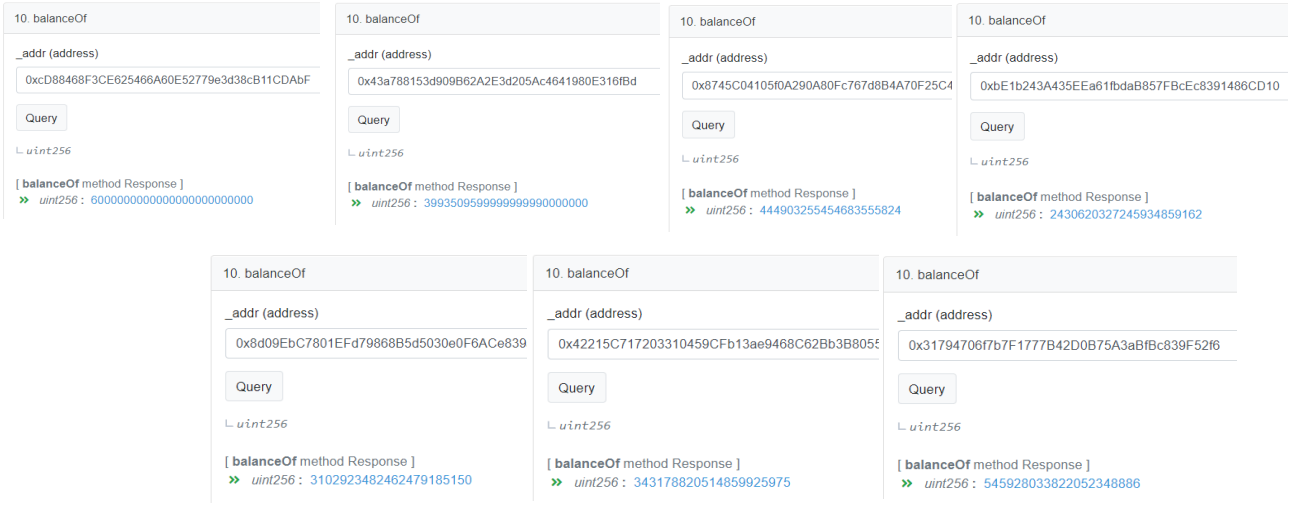
- In the last transaction, Wallet-5 adds liquidity to BakerySwap testnet pool with 750 tokens.

https://testnet.bscscan.com/tx/0x1811d5ab4660673c6d8f3918865f73200b21a4e3ada18b03623bbf9e3ad3e28d

Expected

https://testnet.bscscan.com/tx/0	**Tx Amount**	750	6,000,000	3,993,509.6	432	2,359.2627	3,011.8285	333.1038	529.9008	**Included Supply**
Add Liq-5	**Fee**	15			0.9706	0.9706	0.9706	0.9706	0.9706	6,868
		6			444.903255454684	2,430.62032724594	3,102.92348246248	343.17882051486	545.928033822052	

Results

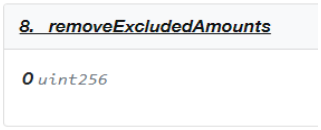


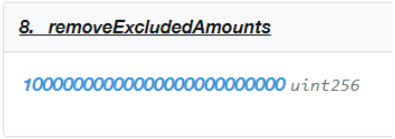
General Tests

- Check that the total token balance of excluded accounts is calculated correctly, *_removeExcludedAmounts*

https://testnet.bscscan.com/tx/0xf6a27603449cdfc0d265677cff7c1073500650c5365d1a4f1bf84bb71c177537

In contract creation, 10M tokens are sent to the contract owner. Before the contract owner is excluded, the value for *removeExcludedAmounts* is zero. This value is updated to 10M after the contract owner was excluded.





- Check that functions specific to the contract owner can only be used by the contract owner

- *excludeAccount*
- *includeAccount*
- *excludeFromTax*
- *updateTCMultiplier*
- *addLPToken*
- *updateminTCamount*
- *transferOwnership*
- *updateHolderFee*
- *updateLPStakerFee*
- *updateTCFee*

- During the tests, functions specific to the contract owner are used by the contract owner and an account that is not the contract owner. Transactions in which functions are used by the contract owner should be successful, but transactions made with the other account should fail.

excludeAccount:

Contract Owner:

https://testnet.bscscan.com/tx/0xf6a27603449cdfc0d265677cff7c1073500650c5365d1a4f1bf84bb71c177537

Non-Contract Owner:

https://testnet.bscscan.com/tx/0x1e533a860cd70989407b5cd5e944b1b5faf272c14e80cf6545f28f901d7805d2

includeAccount

Contract Owner:

https://testnet.bscscan.com/tx/0x34a7b07e6c586191d3f36a9bcba0c1b2fe1722374c5afae1428170537ff69ece

Non-Contract Owner:

https://testnet.bscscan.com/tx/0x2e06a164bea3806cd33e25b0c99dbf832ab05a7bc533f9859667ffe342cd92f9

excludeFromTax

Contract Owner:

https://testnet.bscscan.com/tx/0xd100e753382a21aa05d462083d3adabdfb64614fa0604f2749d6556180f723b3

Non-Contract Owner:

https://testnet.bscscan.com/tx/0x49aedb9a6fb2614411abf15fb89bc8cc30856761b249b6c994c1b9d0b3606019

updateTCMultiplier

Contract Owner:

https://testnet.bscscan.com/tx/0x0bdfca409cdbeeb159b98d10fd9b0fbde42600c32ad898f415e835ecbf6bc8ee

Non-Contract Owner:

https://testnet.bscscan.com/tx/0x0f130bc8364153081a07c073a859e3c36f831a819dc5b702d3df538d58a480fc

addLPToken

Contract Owner:

https://testnet.bscscan.com/tx/0x72bb247d3edb013717fabe3c0bcaf9a8114f74a4b7a4992ef8a48b4591a818cf

Non-Contract Owner:

https://testnet.bscscan.com/tx/0x11a377fc79a169e936ba3d791fa81f67fd4cc645a4608369a0ff65cb59af2961

updateminTCamount

Contract Owner:

https://testnet.bscscan.com/tx/0xedbcabed4497eb74825a5e948b00e7282601309ed94dd22e9cb1e307a55b291f

Non-Contract Owner:

https://testnet.bscscan.com/tx/0xbee300648105180e5dd7462f8f115bbdb79aa0d5c89e7faa48dc05cec25e6aa4

-At this stage, the contract owner has been transferred from Wallet-1 (Wallet-ID = AbF) to Wallet-2 (Wallet-ID = 603). On the following steps, contract owner specific functions were used by the new contract owner, Wallet-2.

transferOwnership

Contract Owner:

https://testnet.bscscan.com/tx/0xbfeefa83caa7d8cc197f219e3fd30a051884302d7031539d2aeb29195de5542a

Non-Contract Owner:

https://testnet.bscscan.com/tx/0xc3e2fc201e5eed651984e1445c8f03b4e0047275c46abd18a4fecfa8cb471830

updateHolderFee

Contract Owner:

https://testnet.bscscan.com/tx/0x631d6d6d03e3abbc0cad1ccd472ec5cddd60001dbd3e1940e8d29983f06dc3c1

Non-Contract Owner:

https://testnet.bscscan.com/tx/0xad9e080d67e5c6ca779275c0ead93db8bfc59eb97f1d538abdb9ad68b800d87f

updateLPStakerFee

Contract Owner:

https://testnet.bscscan.com/tx/0x5b709b78cf21645c21c336cb912db6d68bc2c4b35e58d878c2717b32a4060913

Non-Contract Owner:

https://testnet.bscscan.com/tx/0x2444fe8a4773b2e8702764dd252a7a5458123a948e528810590a7fb59fab9160

updateTCFee

Contract Owner:

https://testnet.bscscan.com/tx/0xd789d33f8a1a0b4a521f9275a537d1592319e964ddcaaec2bf6c92ba579fd2c0

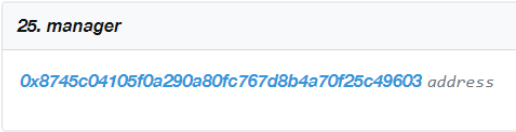
Non-Contract Owner:

https://testnet.bscscan.com/tx/0x22051c01a785db50aaefee4d4c6cd537c13b7d0ca6165147e8c9d639db956a70

- Check that the contract owner check returns the correct address as the owner, *isManager*

Ownership of the contract is transferred to Wallet-2 in the following transaction.

https://testnet.bscscan.com/tx/0xbfeefa83caa7d8cc197f219e3fd30a051884302d7031539d2aeb29195de5542a



- Check that the properties specific to the excluded accounts works correctly, *excludeAccount*

-Accounts excluded cannot benefit from holder rewards.

- Exclude the contract owner

https://testnet.bscscan.com/tx/0x0021f62feb83e4a4aa0ff3d69f807fd8e04a9e69d31d61ae0b6aa34fd81e3fdb

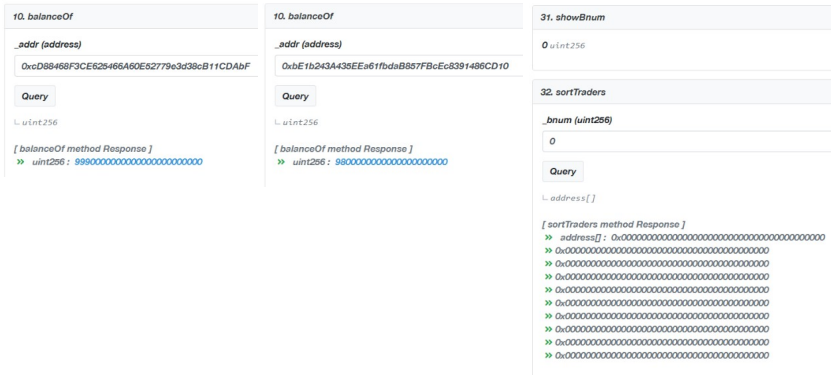
- Exclude Wallet-3 (Wallet-ID = D10)

https://testnet.bscscan.com/tx/0xa65dd85a35fec64fe8991f88b031d33d0deceddf5c03d1f3ebed9d354e1c2cdc

- Transfer 10,000 tokens from the contract owner to Wallet-3.

https://testnet.bscscan.com/tx/0x1fd5e4bda0da239f14236edda7a3385efada28477714aa0f24c5fb6ca52bf6b2

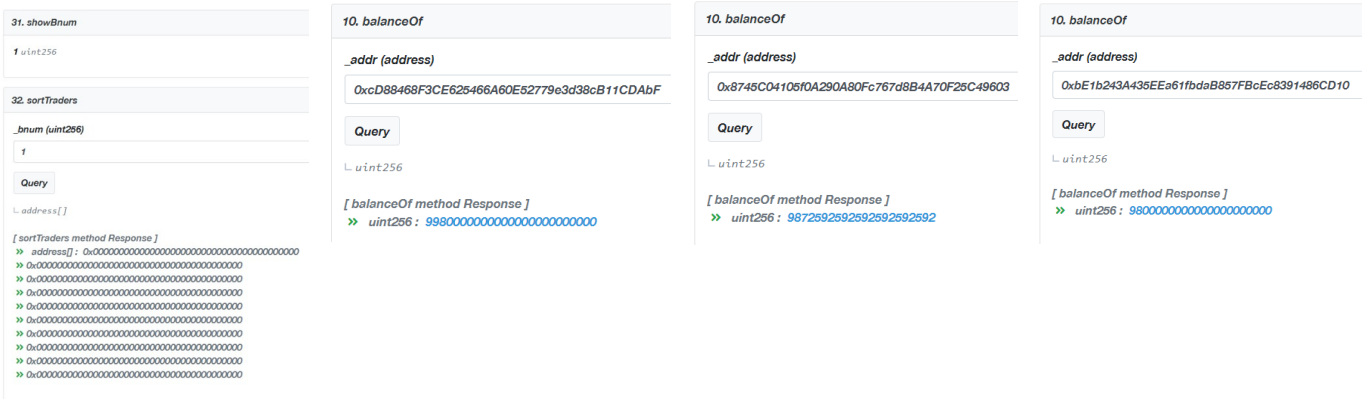
- Contract owner and Wallet-3 did not receive holder reward after the transfer. Wallet-3 did not participate in the trading competition since both accounts are excluded.



- If the address that sends the tokens is excluded, but the contract owner, then the token receiver cannot participate in the trading competition.

- *Transfer 10.000 tokens from the contract owner to Wallet-2 (Wallet-ID: 603)*

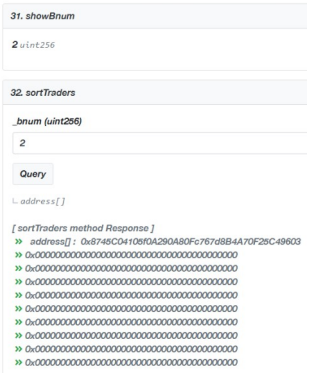
https://testnet.bscscan.com/tx/0x3d1f8e2e65a78e0e9300856da45b55bb8f3e780d382c3636045262bbf1aeffab



- If the address that sends the tokens is excluded but not the contract owner, then the token receiver participates in the trading competition.

- *Transfer 5.000 tokens from Wallet-3 to Wallet-2 (Wallet-ID: 603)*

https://testnet.bscscan.com/tx/0xfffa031bd698714a104ae9f4f93074e317fd8b612426ace3e448895d04c9d38c



- 2% fee should not be charged for the transactions made by the accounts made exempt from transaction fees.

- Contract owner excludes Wallet-2 from transaction fees, ***excludeFromTax***

https://testnet.bscscan.com/tx/0x18c13fa335729bc47033e38706c24a3ce873452dcc1be404f3963dad3f10190d

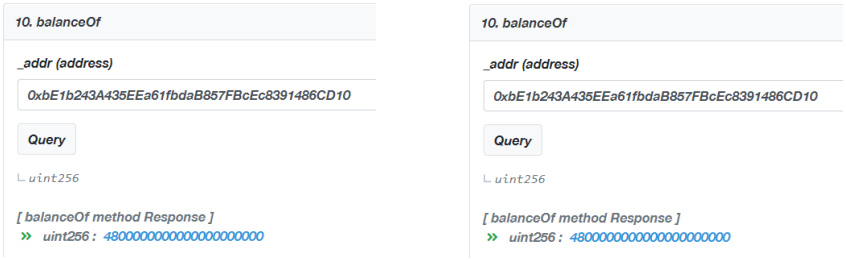
- On the next transaction Wallet-2 transfers 5000 tokens and is not charged 2% fee from the transaction.

https://testnet.bscscan.com/tx/0xc7996a450f6e601b723e00aa4102fe56a0454359233562e2c03a92ca26795621

- Check that the accounts included as holders can reuse the features specific to the holders, *includeAccount*

- Wallet-3 is removed from the list of excluded accounts and becomes a holder again.

- Check the balance of Wallet-3 before and after the include process

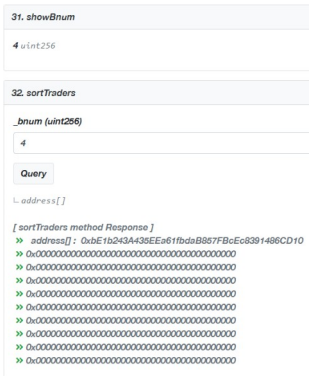


- Check that Wallet-3 can now participate in the trading competition

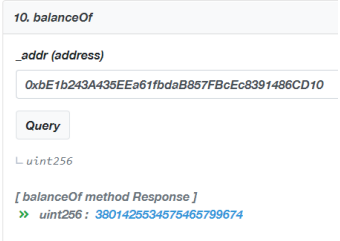
- Check that accounts to which included accounts send tokens are not included in the trading competition.

- Wallet-3 sends 1000 tokens to Wallet-4 and only Wallet-3 is added to the trading competition list.

https://testnet.bscscan.com/tx/0xd81e8563a704ce92ba5b42960afb397dfc18619bd79c8f479dde8282a6c0cb10



- Included accounts should start receiving the holder rewards again. Before transferring 1000 tokens, Wallet-3 balance had 4800 tokens. When the user transferred 1000 more tokens, there are more tokens than there should be, 3800 tokens, since Wallet-3 has started to receive holder rewards again.



- Check if the token mint stops after the PERA token emission expiration date, *tenYearsasBlock*

- The mint expiration time of the smart contract used in the test is defined as 7 cycles. Wallet-3 enters the 29th cycle trading competition and claims its competition reward within the 30th cycle. Wallet-3 trades with 100.000 tokens within the 29th cycle. The rewards to be claimed by the user should only come from the fee received from this transaction, and not the mint rewards.

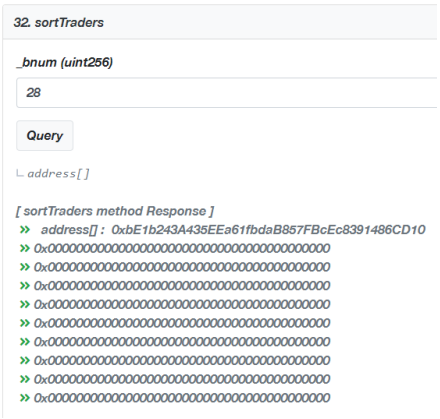
https://testnet.bscscan.com/tx/0x7e57218d5d6ce5aceb8f7d7cd1d7e7873270f6b91b85dc7b2d0f2ac80d089a0f

User's reward can be calculated as

User's Rewards = 100.000 * 0.005 * 0.19 * 0.51 = 18.45

- It can be checked from the tx hash below that the theoretical result and the calculations made by the smart contract are the same.

https://testnet.bscscan.com/tx/0x8754e6ad28a9c94c2fe8293d5068b53ac5a1045171823babe14c87e5beafa62f



- Minting of PERA tokens is possible only through the trading competition or the claim of LP token staker rewards. It has been checked whether the amount of tokens minted during the trading competition reward claims and LP token withdrawals is reflected in the total supply correctly.

- Wallet-2 stakes 50 LP tokens and after staking for a while, it withdraws LP tokens.

Deposit (at block number 8497583)

https://testnet.bscscan.com/tx/0x6ee6032913d115efb97799b01184007ef8e33f1b731e0430c28ccd36ed259ee4

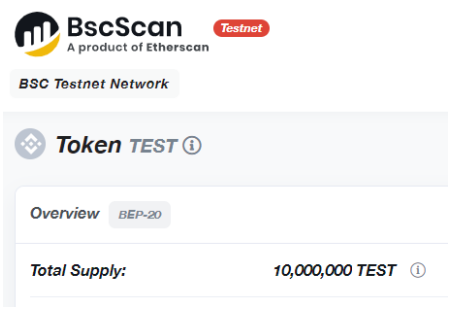
Withdraw (at block number 8497665)

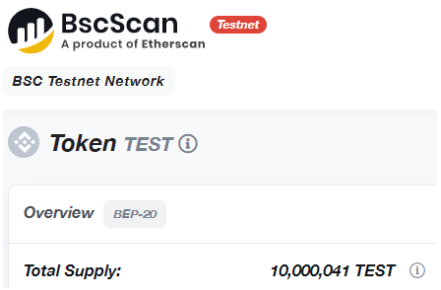
https://testnet.bscscan.com/tx/0xb66dd0a23575b935427c799e98de0be0abbc7b69a794fb62eb390dda1c4f03c8

- Considering the block interval the user stays in the LP staking, the amount of token that the smart contract should mint can be calculated as follows.

User's Mint Rewards = 0.5 * (8497665 – 8497583)

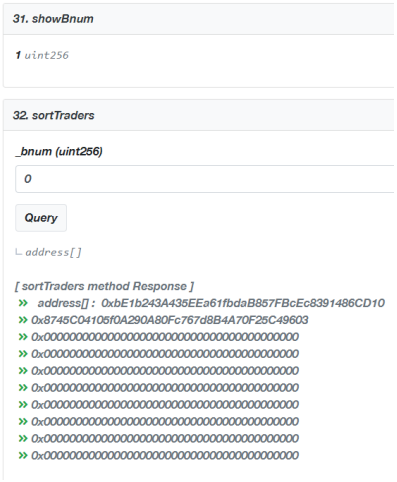
= 41 Tokens





- Wallet-3 claims the trading competition rewards on the 2nd day after winning the competition on the 1st day. The smart contract used in the test mints 5600 tokens daily for the competition. Accordingly, when the user claims the competition rewards, the amount that the contract should mint can be calculated as follows.
https://testnet.bscscan.com/tx/0x6a9a3b665da6fcd3022fbc8697c52a3e94cbe57e85ad6187d25855c36044dcc2

User's Mint Rewards = 5600 * 0.19 * 0.51 = 542.64 Tokens



- If we take into account the minted tokens for the LP token staker, the total number of minted tokens should be

Total Mint = 41 + 542.64 = 583.64 Tokens