COEN 241 HW 1

System Vs OS Virtualization

Project Report

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Detailed configurations

Detailed configurations of the experimental setup I have used for the homework are as follows:

- **Processor:** 12th Gen Intel® Core™ i5-12400F × 12
- **Memory:** 16.0 GiB
- **OS Name:** Fedora Linux 37 (Workstation Edition)
- **OS Type:** 64-bit
- **Disk Capacity:** 500.1 GB
- **Hardware Model:** Gigabyte Technology Co., Ltd. B660M DS3H AX DDR4
- **Graphics:** NVIDIA GeForce RTX™ 3050

System Virtualization (QEMU) Setup

QEMU Virtual Machine Deployment

Introduction

This report details the steps taken to enable a QEMU virtual machine (VM) on a Fedora Linux 37 system. The goal was to install an Ubuntu Server (provided as an ISO file) using QEMU commands and appropriate VM configurations.

QEMU Virtual Machine Configuration

In this section, we will go through the steps to enable a QEMU virtual machine on a Fedora Linux 37 operating system. The virtual machine will run an Ubuntu Server, using the ISO file provided in the assignment.

The following are the commands and configurations used to install the QEMU virtual machine:

1. **Installing QEMU**:
   To install QEMU, we run the following command in the terminal:sh

```
$ sudo dnf install qemu
```

2. **Creating a QEMU Image**:
   Once QEMU is installed, we create a QEMU Image by running the following command in the terminal: (This command creates a virtual image with 10 GiB of disk space.)

```
$ sudo qemu-img create ubuntu.img 10G -f qcow2
```

3. **Installing Ubuntu Server VM**:
   Once the Ubuntu image is created, we install the virtual machine by running the following command in the terminal: (This command boots the virtual machine and installs the Ubuntu Server.)

```
$ sudo qemu-system-x86_64 -hda ubuntu.img -boot d -cdrom ./ubuntu.img -m 2046 -
boot strict=on
```

The following are the explanations of the configurations used in the third command:

- `qemu-system-x86_64`: represents the normal QEMU command for an x86_64 machine.
- `-hda [file]`: specifies the image file for the virtual IDE hard disk. In this case, it is `ubuntu.img`.
- `-boot [a | c | d | n]`: boot from floppy disk (a), hard disk (c), CD-ROM (d), or etherboot (n). In this case, we boot from the CD-ROM.
- `-cdrom – use iso image as cdrom to install ubuntu`: specifies that we are using the ISO image as a CD-ROM to install Ubuntu.
- `-m 2048`: allocates 2048 MB of RAM for the virtual machine.
- `-accel [accel]`: specifies the accelerator for virtual machine execution. In this case, it is not specified, so the default value is used. QEMU supports multiple accelerator options, including KVM, Xen, and TCG. Here, by default qemu uses TCG.

OS Virtualization (Docker) Setup

In this assignment, the setup of Docker was performed using the following two documentations:

- https://docs.docker.com/engine/install/fedora/
- https://developer.fedoraproject.org/tools/docker/docker-installation.html

The first step involved uninstalling any older versions of Docker along with associated dependencies. The latest version of Docker was then installed from its repository. To verify the installation, the hello-world image was executed to ensure that Docker was functioning as expected.

Setting up the Docker Container

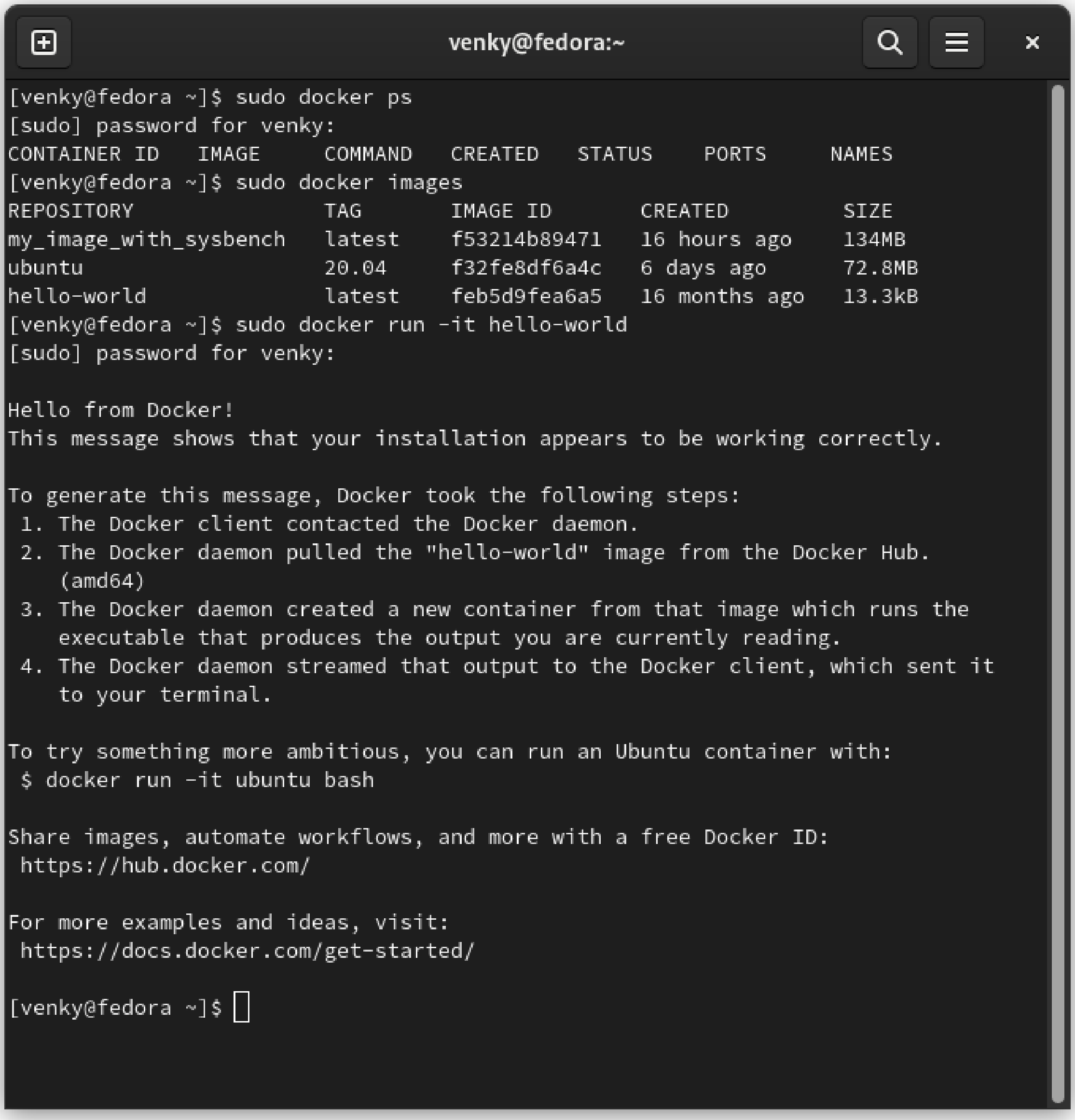
To set up the Docker container, the following steps were taken:

- Verification of image creation was performed using the command `sudo docker images`.
- The Docker container was created using the command `sudo docker run -it ubuntu:20.04`. This pulled the ubuntu:20.04 image, created a container from it, and ran the Bash shell inside it.

- The base ubuntu image was utilized to create a new image with Sysbench installed by updating the base image using the command `apt update` and installing Sysbench using the command `apt install sysbench`.
- The new image was created using the command `sudo docker commit <container_id> my_image_with_sysbench`, where `<container_id>` is the ID of the running container.
- The history of the newly created image was inspected using the command `docker history my_image_with_sysbench`.

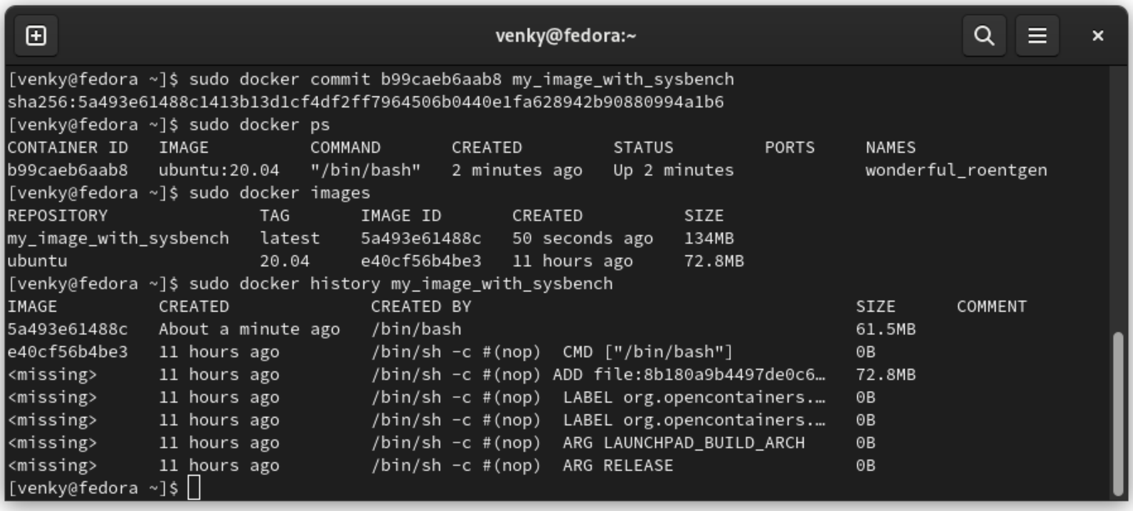
The following commands were used to list the running containers and verify the images available locally:

- `sudo docker ps`: To list running containers
- `sudo docker images`: To see the available images locally.



```
[venky@fedora ~]$ sudo docker ps
[sudo] password for venky:
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
[venky@fedora ~]$ sudo docker images
REPOSITORY              TAG       IMAGE ID       CREATED          SIZE
my_image_with_sysbench   latest    f53214b89471   16 hours ago     134MB
ubuntu                  20.04     f32fe8df6a4c   6 days ago       72.8MB
hello-world             latest    feb5d9fea6a5   16 months ago    13.3kB
[venky@fedora ~]$ sudo docker run -it hello-world
[sudo] password for venky:

Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
    (amd64)
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.

To try something more ambitious, you can run an Ubuntu container with:
 $ docker run -it ubuntu bash

Share images, automate workflows, and more with a free Docker ID:
 https://hub.docker.com/

For more examples and ideas, visit:
 https://docs.docker.com/get-started/

[venky@fedora ~]$ 
```

docker_start_01



```
[venky@fedora ~]$ sudo docker commit b99caeb6aab8 my_image_with_sysbench
sha256:5a493e61488c1413b13d1cf4df2ff7964506b0440e1fa628942b90880994a1b6
[venky@fedora ~]$ sudo docker ps
CONTAINER ID   IMAGE          COMMAND       CREATED         STATUS         PORTS     NAMES
b99caeb6aab8   ubuntu:20.04   "/bin/bash"   2 minutes ago   Up 2 minutes             wonderful_roentgen
[venky@fedora ~]$ sudo docker images
REPOSITORY               TAG       IMAGE ID       CREATED          SIZE
my_image_with_sysbench   latest    5a493e61488c   50 seconds ago   134MB
ubuntu                   20.04     e40cf56b4be3   11 hours ago     72.8MB
[venky@fedora ~]$ sudo docker history my_image_with_sysbench
IMAGE          CREATED              CREATED BY                                      SIZE      COMMENT
5a493e61488c   About a minute ago   /bin/bash                                       61.5MB
e40cf56b4be3   11 hours ago         /bin/sh -c #(nop)  CMD ["/bin/bash"]            0B
<missing>      11 hours ago         /bin/sh -c #(nop) ADD file:8b180a9b4497de0c6…   72.8MB
<missing>      11 hours ago         /bin/sh -c #(nop)  LABEL org.opencontainers.…   0B
<missing>      11 hours ago         /bin/sh -c #(nop)  LABEL org.opencontainers.…   0B
<missing>      11 hours ago         /bin/sh -c #(nop)  ARG LAUNCHPAD_BUILD_ARCH     0B
<missing>      11 hours ago         /bin/sh -c #(nop)  ARG RELEASE                  0B
[venky@fedora ~]$ 
```

docker_start_02

Benchmarking

Prior to initiating the benchmarking process, it was ensured that both QEMU and Docker were utilizing the same versions of Ubuntu 20.04.5 LTS and Sysbench 1.0.18.

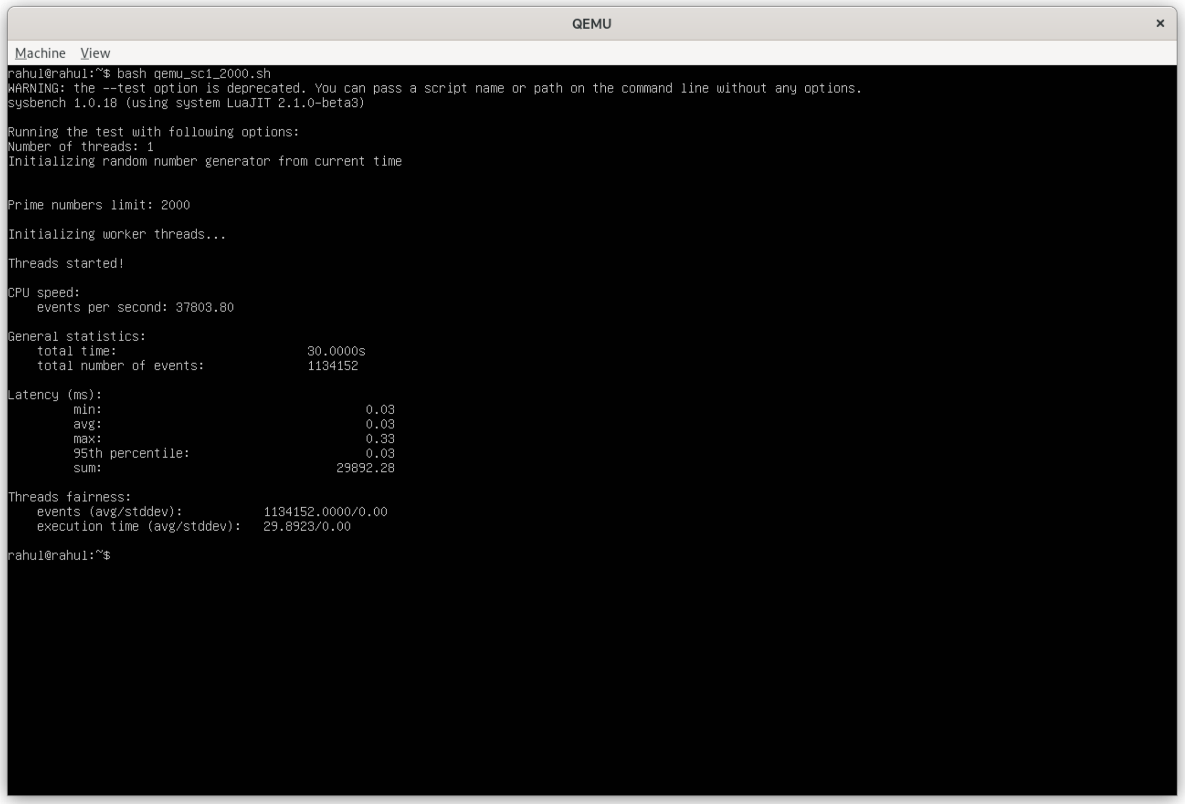
QEMU setup experiments:

After conducting a series of tests with various arguments, it was found that the use of the -accel kvm option significantly improved the performance of the virtual machine(attached the screenshots below). The use of the Kernel-based Virtual Machine (KVM) accelerator provided a significant increase in the speed and responsiveness of the virtual machine compared to the default accelerator tcg tested. Even the boot times were blazingly fast after using the kvm accelerator.

VM Configuration	Events per second
with kvm accelerator	37803.80
with default(tcg) accelerator	7530.89
with kvm accelerator and smp set to max=12	37558.62

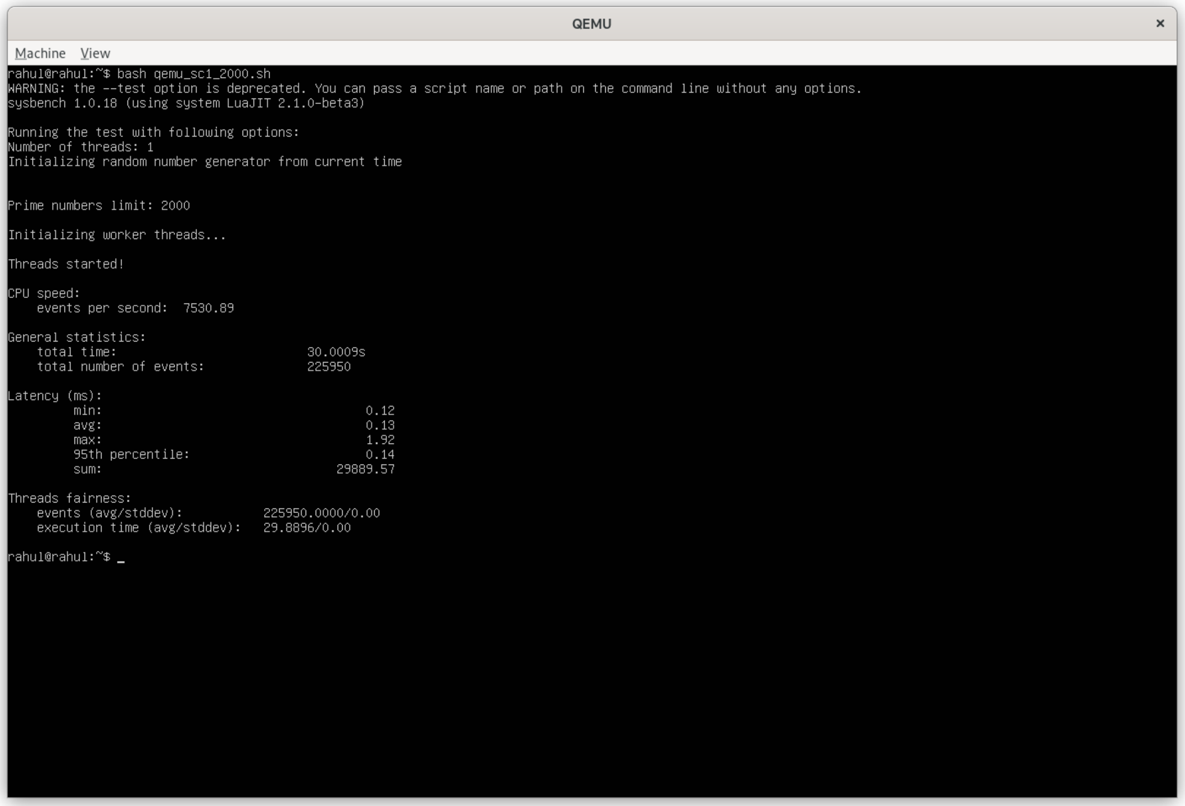
Due to minimal change observed in increasing the number of hot-pluggable CPUs to its maximum of 12 using SMP for KVM, we will proceed with utilizing the KVM accelerator for the remaining benchmark experiments. We use the following command to start the Ubuntu VM

```
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img -accel kvm
```



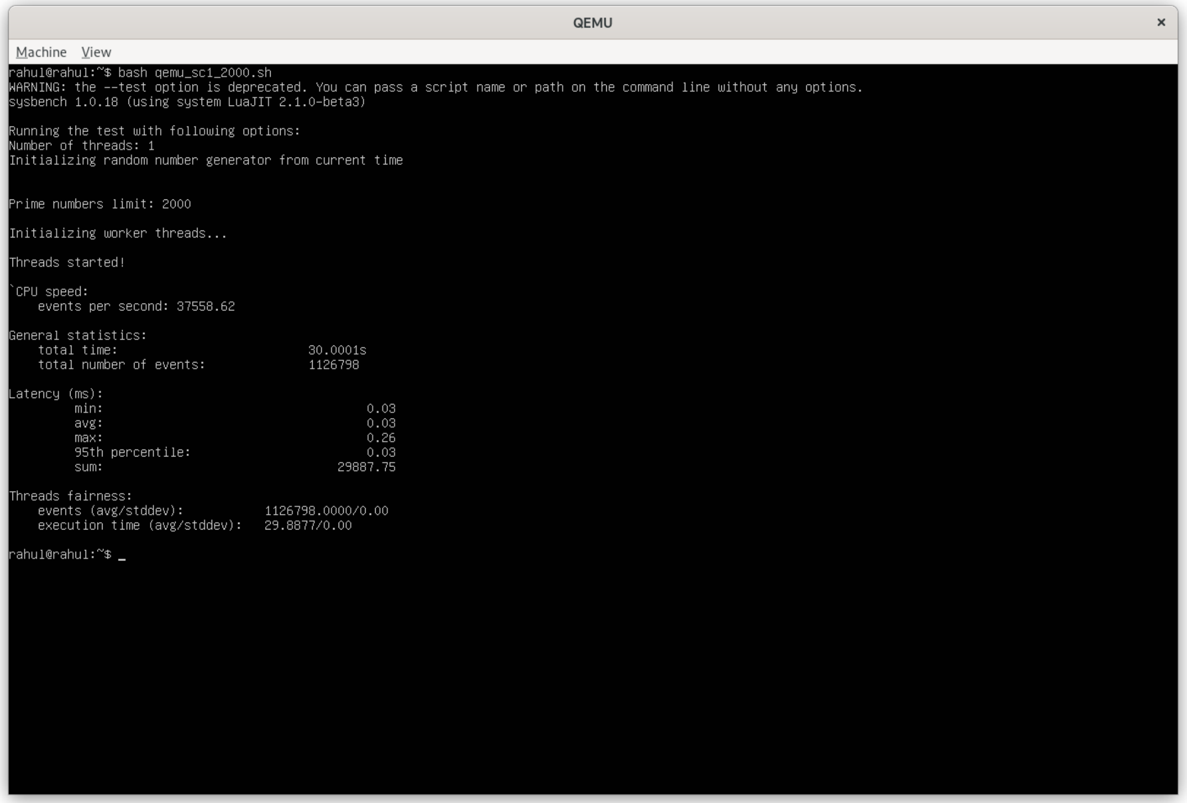
```
rahul@rahul:~$ bash qemu_sc1_2000.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37803.80

General statistics:
    total time:                          30.0000s
    total number of events:              1134152

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.33
         95th percentile:                        0.03
         sum:                                29892.28

Threads fairness:
    events (avg/stddev):           1134152.0000/0.00
    execution time (avg/stddev):   29.8923/0.00

rahul@rahul:~$
```

qemu_kvm



```
rahul@rahul:~$ bash qemu_sc1_2000.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  7530.89

General statistics:
    total time:                          30.0009s
    total number of events:              225950

Latency (ms):
         min:                                    0.12
         avg:                                    0.13
         max:                                    1.92
         95th percentile:                        0.14
         sum:                                29889.57

Threads fairness:
    events (avg/stddev):           225950.0000/0.00
    execution time (avg/stddev):   29.8896/0.00

rahul@rahul:~$ _
```

qemu_without_kvm



```
rahul@rahul:~$ bash qemu_sc1_2000.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

`CPU speed:
    events per second: 37558.62

General statistics:
    total time:                          30.0001s
    total number of events:              1126798

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.26
         95th percentile:                        0.03
         sum:                                29887.75

Threads fairness:
    events (avg/stddev):           1126798.0000/0.00
    execution time (avg/stddev):   29.8877/0.00

rahul@rahul:~$ _
```

qemu_kvm_smp_max_12

Scenarios and Test cases:

Performance data collection can be performed using the sysbench tool, which provides various modes for measuring CPU utilization and I/O performance.

To measure CPU utilization, we can use the following sysbench commands:

- `sysbench cpu`: Measures user-level CPU performance by executing mathematical operations. Results include the number of events executed per second and the total time taken to execute the events.
- `sysbench fileio`: Measures kernel-level CPU utilization during file I/O operations. Results include information about the CPU utilization during these operations.

To measure I/O performance, we can use the following sysbench command:

- `sysbench fileio`: Measures file I/O performance. Results include I/O throughput, latency, and disk utilization, with I/O throughput being the number of I/O operations per second, latency being the average time taken to complete an I/O operation, and disk utilization being the amount of disk space used during the test.

In conclusion, sysbench provides valuable information for performance analysis and optimization through its various modes for measuring CPU utilization and I/O performance. The code below contains the test cases for the first scenario, and the remaining test cases and scenarios can be found in the GitHub repository.

Testcases for Scenarios

```
#test-case-01-cpu-2000
sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
#test-case-02-cpu-20000
sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
#test-case-03-cpu-100000
sysbench --test=cpu --cpu-max-prime=100000 --time=30 run
#test-case-04-io-rndrw
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw cleanup
#test-case-05-io-seqrewr
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr cleanup
```

Scenarios

Shell scripts have been developed to automate the repetition of necessary commands. Each test case must be executed five times, and the corresponding shell scripts can be found in the GitHub repository. The use of these scripts streamlines the process of repeating the tests multiple times and ensures consistency in the data collected.

In QEMU, virtual scenarios will be established during the start-up of the virtual machine (VM), using the following commands:

```
#scenario-1 : 2 GiB of RAM allocated with kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img -accel kvm
#scenario-2 : 2 GiB of RAM allocated without kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img
#scenario-3 : 8 GiB of RAM allocated with kvm accelerator and smp set to max=12
$ sudo qemu-system-x86_64 -m 8192 -hda ubuntu.img -accel kvm -smp 12
```

Whereas for Docker Virtualizations, the script files innately allocate the set amounts of memory(RAM), and CPUs for their respective scenarios. The following commands are used to start-up the three different docker container scenarios.

```
#scenario-1 : 2 GiB of RAM, 2 CPUs allocated
$ sudo docker run -it --cpus="2" --memory="2g" my_image_with_sysbench:latest
#scenario-2 : 4 GiB of RAM, 4 CPUs allocated
$ sudo docker run -it --cpus="4" --memory="4g" my_image_with_sysbench:latest
#scenario-3 : 8 GiB of RAM, 8 CPUs allocated
$ sudo docker run -it --cpus="8" --memory="8g" my_image_with_sysbench:latest
```

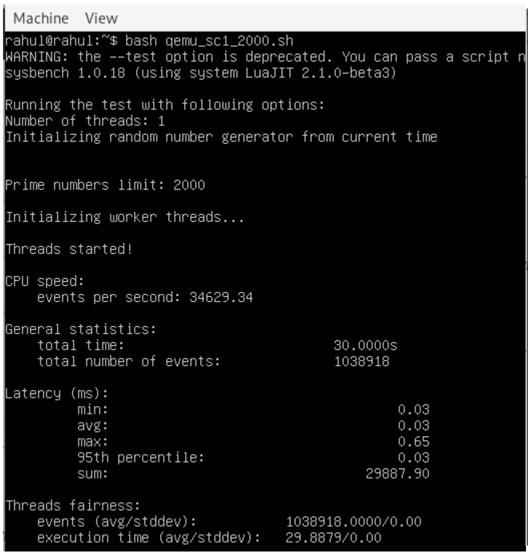
Screenshots QEMU:

The following report depicts screenshots with tables to showcase average values for each scenario and testcase in QEMU Virtualization.

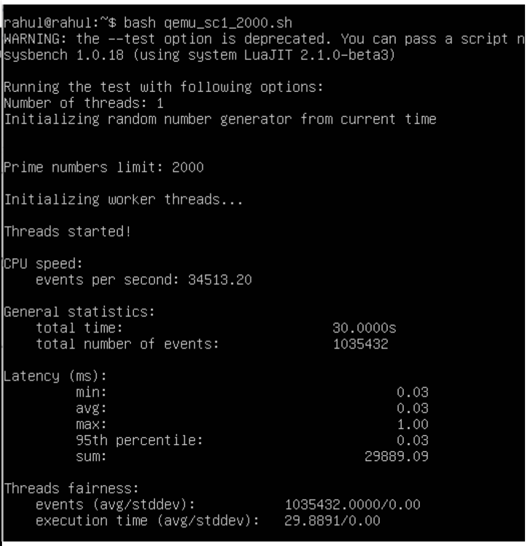
Scenario - 1 & Testcase - 1

These screenshots depict five iterations of testcase 1 in scenario 1 in QEMU VM

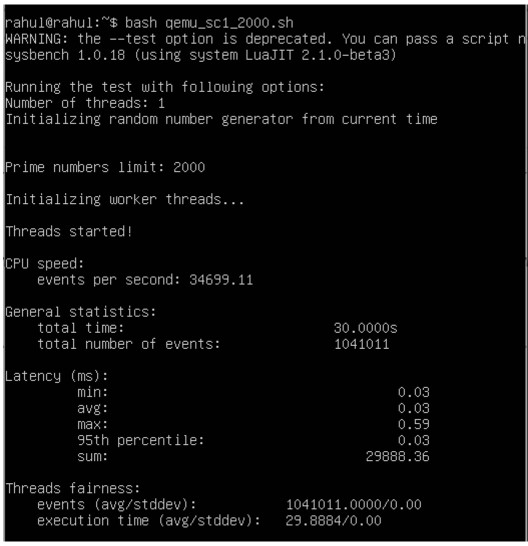
```
#scenario-1 : 2 GiB of RAM allocated with kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img -accel kvm
#test-case-01-cpu-2000
sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
```



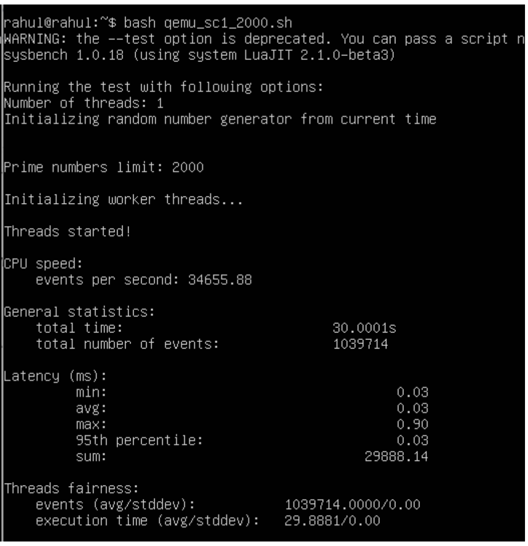
```
rahul@rahul:~$ bash qemu_sc1_2000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34629.34

General statistics:
    total time:                          30.0000s
    total number of events:              1038918

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.65
         95th percentile:                        0.03
         sum:                                29887.90

Threads fairness:
    events (avg/stddev):           1038918.0000/0.00
    execution time (avg/stddev):   29.8879/0.00
```



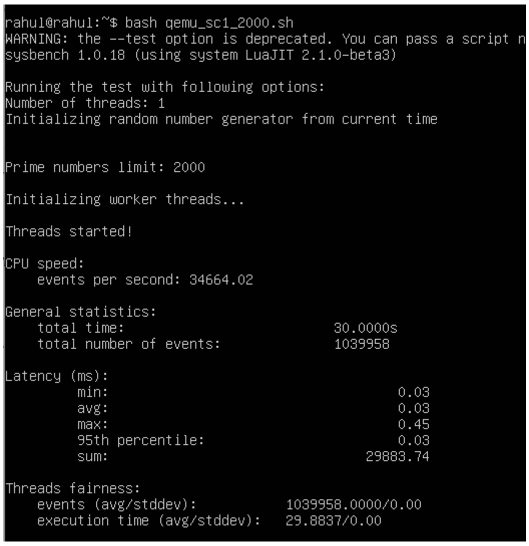
```
rahul@rahul:~$ bash qemu_sc1_2000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34513.20

General statistics:
    total time:                          30.0000s
    total number of events:              1035432

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    1.00
         95th percentile:                        0.03
         sum:                                29889.09

Threads fairness:
    events (avg/stddev):           1035432.0000/0.00
    execution time (avg/stddev):   29.8891/0.00
```



```
rahul@rahul:~$ bash qemu_sc1_2000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34699.11

General statistics:
    total time:                          30.0000s
    total number of events:              1041011

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.59
         95th percentile:                        0.03
         sum:                                29888.36

Threads fairness:
    events (avg/stddev):           1041011.0000/0.00
    execution time (avg/stddev):   29.8884/0.00
```



```
rahul@rahul:~$ bash qemu_sc1_2000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34655.88

General statistics:
    total time:                          30.0001s
    total number of events:              1039714

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.90
         95th percentile:                        0.03
         sum:                                29888.14

Threads fairness:
    events (avg/stddev):           1039714.0000/0.00
    execution time (avg/stddev):   29.8881/0.00
```



```
rahul@rahul:~$ bash qemu_sc1_2000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34664.02

General statistics:
    total time:                          30.0000s
    total number of events:              1039958

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.45
         95th percentile:                        0.03
         sum:                                29883.74

Threads fairness:
    events (avg/stddev):           1039958.0000/0.00
    execution time (avg/stddev):   29.8837/0.00
```

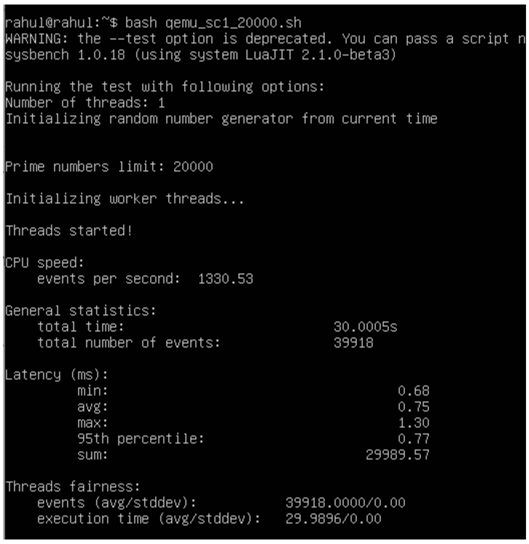
The following table shows the Events per second for test case scenario.

Iteration	Events per second
1	34629.34
2	34513.20 (**MIN**)
3	34699.11 (**MAX**)
4	34655.88
5	34664.02
Average Events per second	34632.31

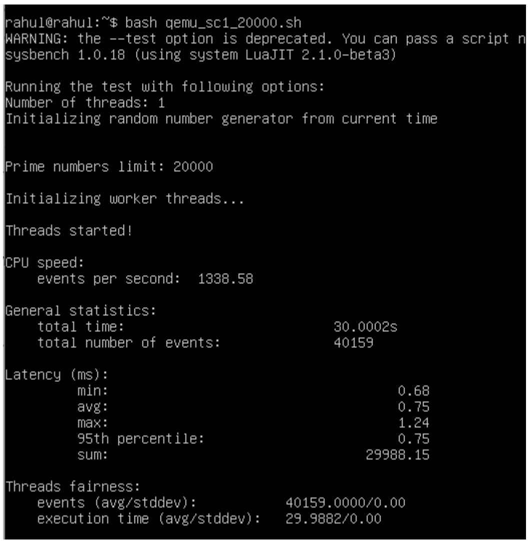
Scenario - 1 & Testcase - 2

These screenshots depict five iterations of testcase 2 in scenario 1 in QEMU VM

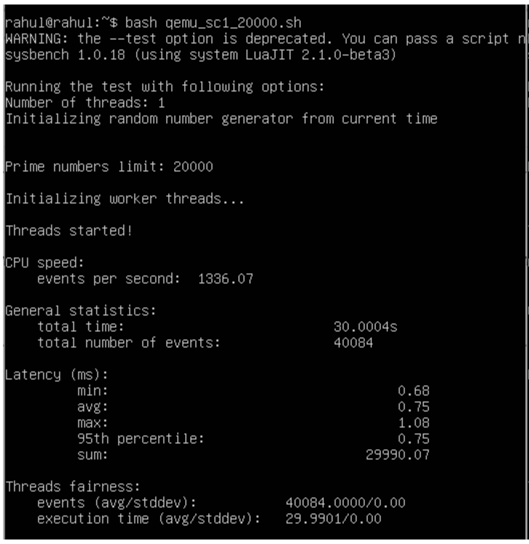
```
#scenario-1 : 2 GiB of RAM allocated with kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img -accel kvm
#test-case-02-cpu-20000
sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
```



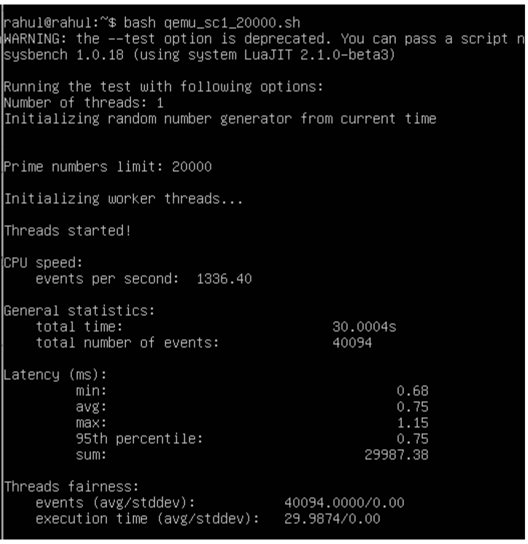
```
rahul@rahul:~$ bash qemu_sc1_20000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1330.53

General statistics:
    total time:                          30.0005s
    total number of events:              39918

Latency (ms):
         min:                                    0.68
         avg:                                    0.75
         max:                                    1.30
         95th percentile:                        0.77
         sum:                                29989.57

Threads fairness:
    events (avg/stddev):           39918.0000/0.00
    execution time (avg/stddev):   29.9896/0.00
```



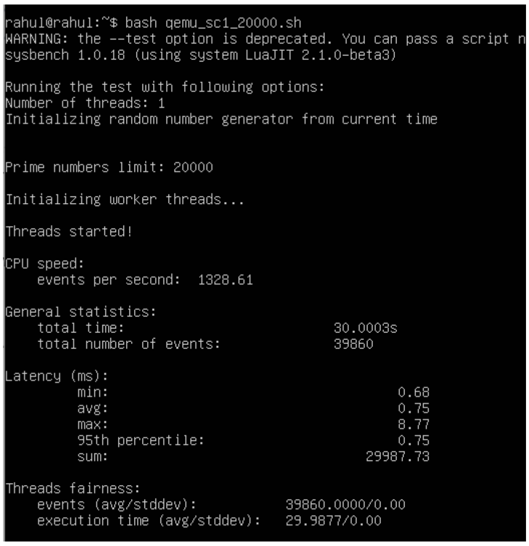
```
rahul@rahul:~$ bash qemu_sc1_20000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1338.58

General statistics:
    total time:                          30.0002s
    total number of events:              40159

Latency (ms):
         min:                                    0.68
         avg:                                    0.75
         max:                                    1.24
         95th percentile:                        0.75
         sum:                                29988.15

Threads fairness:
    events (avg/stddev):           40159.0000/0.00
    execution time (avg/stddev):   29.9882/0.00
```



```
rahul@rahul:~$ bash qemu_sc1_20000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1336.07

General statistics:
    total time:                          30.0004s
    total number of events:              40084

Latency (ms):
         min:                                    0.68
         avg:                                    0.75
         max:                                    1.08
         95th percentile:                        0.75
         sum:                                29990.07

Threads fairness:
    events (avg/stddev):           40084.0000/0.00
    execution time (avg/stddev):   29.9901/0.00
```



```
rahul@rahul:~$ bash qemu_sc1_20000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1336.40

General statistics:
    total time:                          30.0004s
    total number of events:              40094

Latency (ms):
         min:                                    0.68
         avg:                                    0.75
         max:                                    1.15
         95th percentile:                        0.75
         sum:                                29987.38

Threads fairness:
    events (avg/stddev):           40094.0000/0.00
    execution time (avg/stddev):   29.9874/0.00
```



```
rahul@rahul:~$ bash qemu_sc1_20000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1328.61

General statistics:
    total time:                          30.0003s
    total number of events:              39860

Latency (ms):
         min:                                    0.68
         avg:                                    0.75
         max:                                    8.77
         95th percentile:                        0.75
         sum:                                29987.73

Threads fairness:
    events (avg/stddev):           39860.0000/0.00
    execution time (avg/stddev):   29.9877/0.00
```

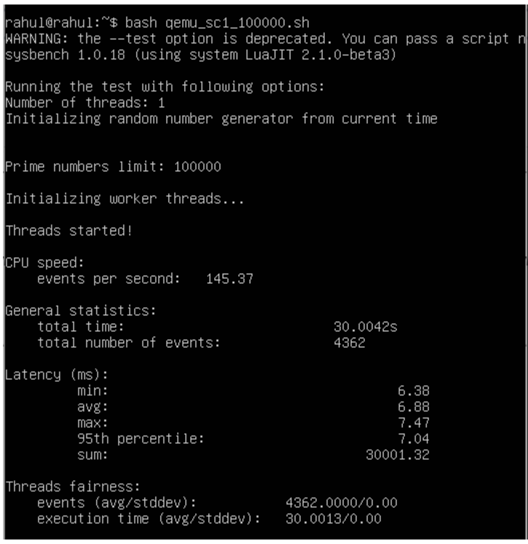
The following table shows the Events per second for test case scenario.

Iteration	Events per second
1	1330.53
2	1338.58 (**MAX**)
3	1336.07
4	1336.40
5	1328.61 (**MIN**)
Average Events per second	1334.038

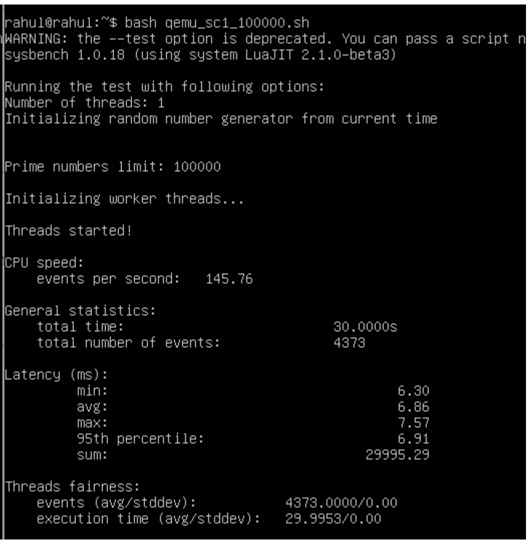
Scenario - 1 & Testcase - 3

These screenshots depict five iterations of testcase 3 in scenario 1 in QEMU VM

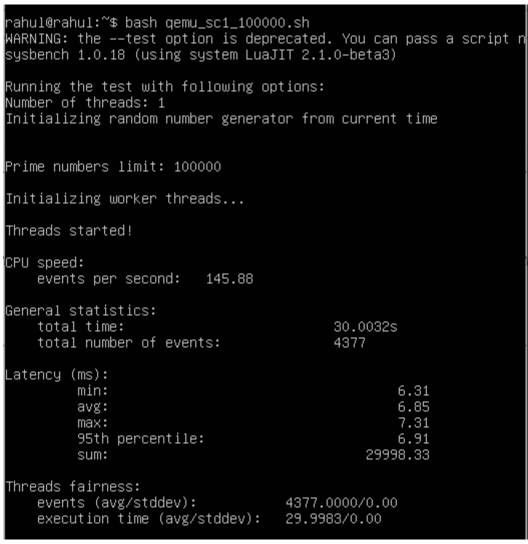
```
#scenario-1 : 2 GiB of RAM allocated with kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img -accel kvm
#test-case-03-cpu-100000
sysbench --test=cpu --cpu-max-prime=100000 --time=30 run
```



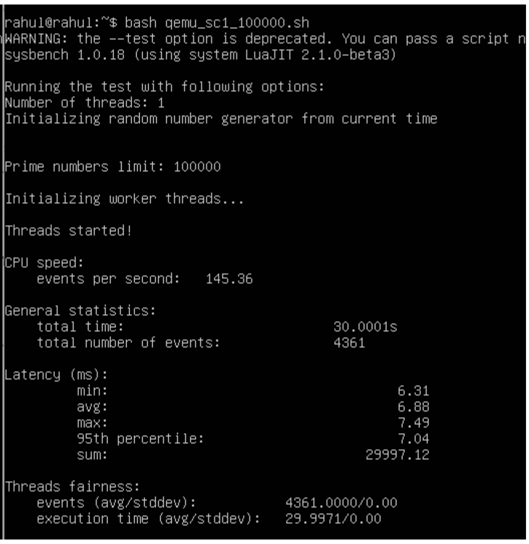
```
rahul@rahul:~$ bash qemu_sc1_100000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.37

General statistics:
    total time:                          30.0042s
    total number of events:              4362

Latency (ms):
         min:                                    6.38
         avg:                                    6.88
         max:                                    7.47
         95th percentile:                        7.04
         sum:                                30001.32

Threads fairness:
    events (avg/stddev):           4362.0000/0.00
    execution time (avg/stddev):   30.0013/0.00
```



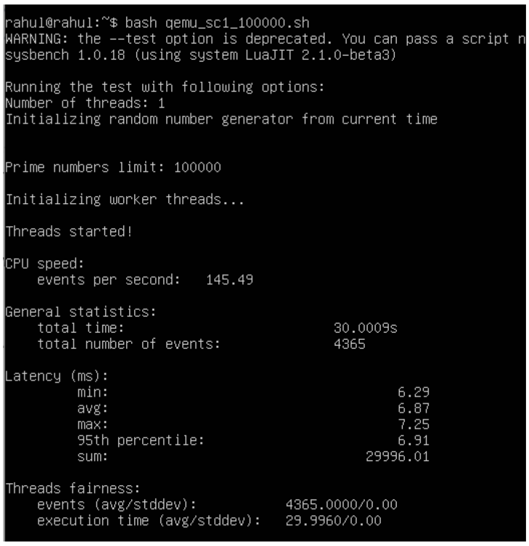
```
rahul@rahul:~$ bash qemu_sc1_100000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.76

General statistics:
    total time:                          30.0000s
    total number of events:              4373

Latency (ms):
         min:                                    6.30
         avg:                                    6.86
         max:                                    7.57
         95th percentile:                        6.91
         sum:                                29995.29

Threads fairness:
    events (avg/stddev):           4373.0000/0.00
    execution time (avg/stddev):   29.9953/0.00
```



```
rahul@rahul:~$ bash qemu_sc1_100000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.88

General statistics:
    total time:                          30.0032s
    total number of events:              4377

Latency (ms):
         min:                                    6.31
         avg:                                    6.85
         max:                                    7.31
         95th percentile:                        6.91
         sum:                                29998.33

Threads fairness:
    events (avg/stddev):           4377.0000/0.00
    execution time (avg/stddev):   29.9983/0.00
```



```
rahul@rahul:~$ bash qemu_sc1_100000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.36

General statistics:
    total time:                          30.0001s
    total number of events:              4361

Latency (ms):
         min:                                    6.31
         avg:                                    6.88
         max:                                    7.49
         95th percentile:                        7.04
         sum:                                29997.12

Threads fairness:
    events (avg/stddev):           4361.0000/0.00
    execution time (avg/stddev):   29.9971/0.00
```



```
rahul@rahul:~$ bash qemu_sc1_100000.sh
WARNING: the --test option is deprecated. You can pass a script n
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.49

General statistics:
    total time:                          30.0009s
    total number of events:              4365

Latency (ms):
         min:                                    6.29
         avg:                                    6.87
         max:                                    7.25
         95th percentile:                        6.91
         sum:                                29996.01

Threads fairness:
    events (avg/stddev):           4365.0000/0.00
    execution time (avg/stddev):   29.9960/0.00
```

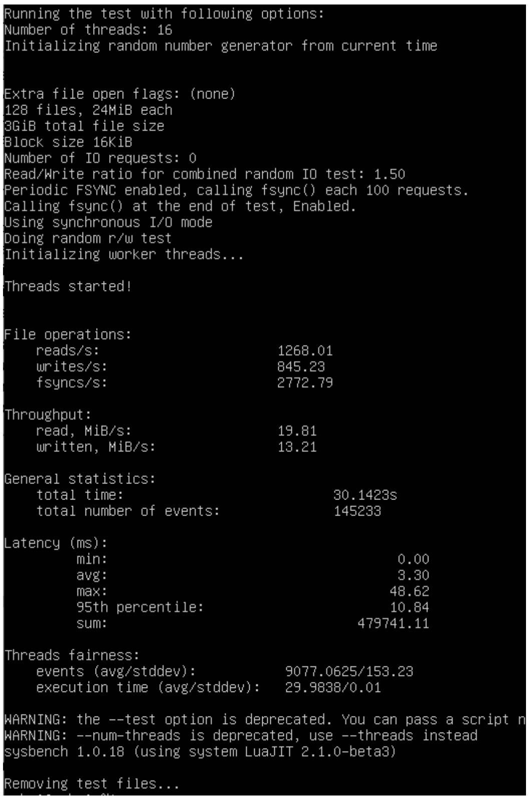
The following table shows the Events per second for test case scenario.

Iteration	Events per second
1	145.37
2	145.76
3	145.88 (**MAX**)
4	145.36 (**MIN**)
5	145.49
Average Events per second	145.57

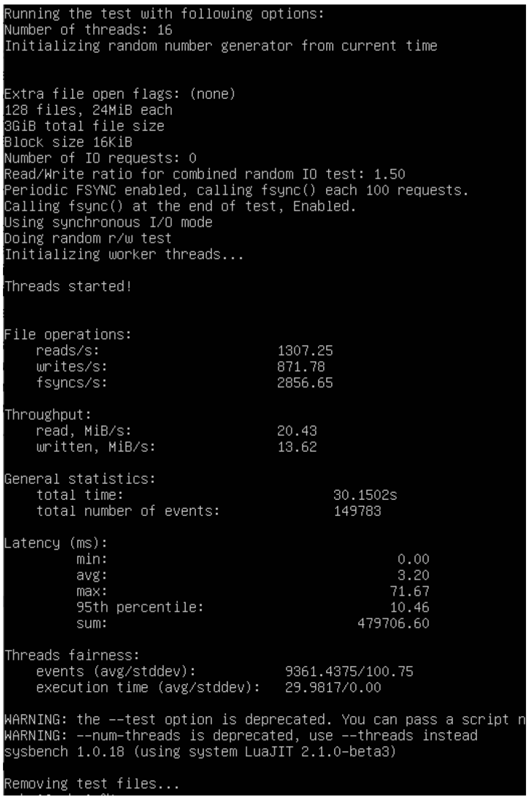
Scenario - 1 & Testcase - 4

These screenshots depict five iterations of testcase 4 in scenario 1 in QEMU VM

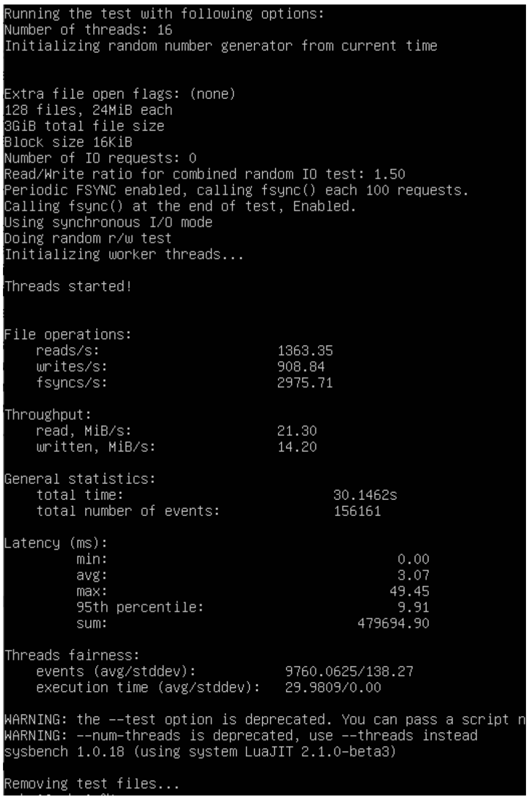
```
#scenario-1 : 2 GiB of RAM allocated with kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img -accel kvm
#test-case-04-io-rndrw
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw cleanup
```



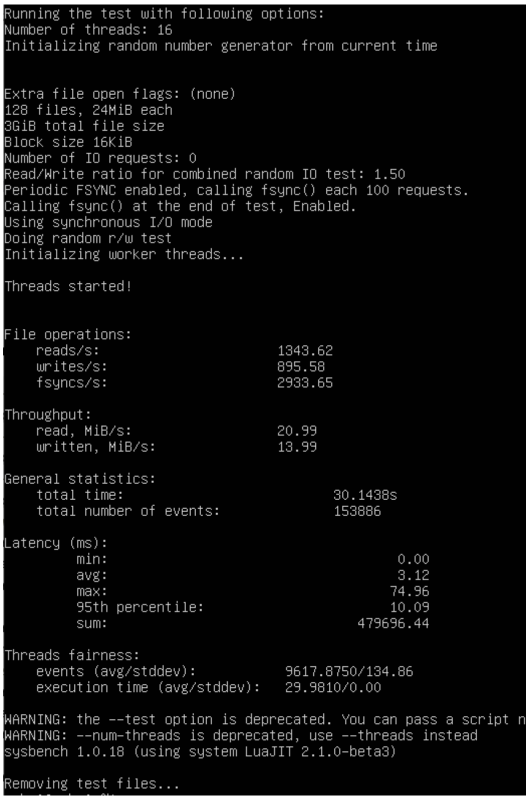
```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1268.01
    writes/s:                     845.23
    fsyncs/s:                     2772.79

Throughput:
    read, MiB/s:                  19.81
    written, MiB/s:               13.21

General statistics:
    total time:                          30.1423s
    total number of events:              145233

Latency (ms):
         min:                                    0.00
         avg:                                    3.30
         max:                                   48.62
         95th percentile:                       10.84
         sum:                               479741.11

Threads fairness:
    events (avg/stddev):           9077.0625/153.23
    execution time (avg/stddev):   29.9838/0.01

WARNING: the --test option is deprecated. You can pass a script n
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



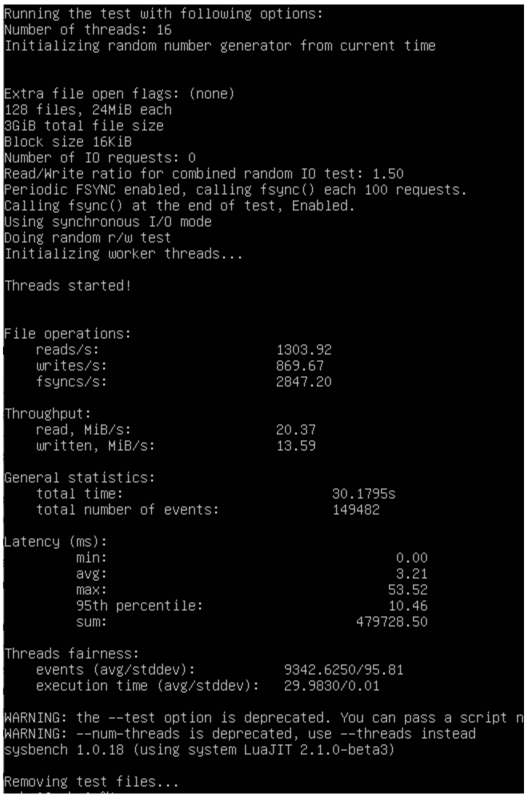
```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1307.25
    writes/s:                     871.78
    fsyncs/s:                     2856.65

Throughput:
    read, MiB/s:                  20.43
    written, MiB/s:               13.62

General statistics:
    total time:                          30.1502s
    total number of events:              149783

Latency (ms):
         min:                                    0.00
         avg:                                    3.20
         max:                                   71.67
         95th percentile:                       10.46
         sum:                               479706.60

Threads fairness:
    events (avg/stddev):           9361.4375/100.75
    execution time (avg/stddev):   29.9817/0.00

WARNING: the --test option is deprecated. You can pass a script n
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1363.35
    writes/s:                     908.84
    fsyncs/s:                     2975.71

Throughput:
    read, MiB/s:                  21.30
    written, MiB/s:               14.20

General statistics:
    total time:                          30.1462s
    total number of events:              156161

Latency (ms):
        min:                                    0.00
        avg:                                    3.07
        max:                                   49.45
        95th percentile:                        9.91
        sum:                               479694.90

Threads fairness:
    events (avg/stddev):           9760.0625/138.27
    execution time (avg/stddev):   29.9809/0.00

WARNING: the --test option is deprecated. You can pass a script n
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1343.62
    writes/s:                     895.58
    fsyncs/s:                     2933.65

Throughput:
    read, MiB/s:                  20.99
    written, MiB/s:               13.99

General statistics:
    total time:                          30.1438s
    total number of events:              153886

Latency (ms):
        min:                                    0.00
        avg:                                    3.12
        max:                                   74.96
        95th percentile:                       10.09
        sum:                               479696.44

Threads fairness:
    events (avg/stddev):           9617.8750/134.86
    execution time (avg/stddev):   29.9810/0.00

WARNING: the --test option is deprecated. You can pass a script n
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1303.92
    writes/s:                     869.67
    fsyncs/s:                     2847.20

Throughput:
    read, MiB/s:                  20.37
    written, MiB/s:               13.59

General statistics:
    total time:                          30.1795s
    total number of events:              149482

Latency (ms):
        min:                                    0.00
        avg:                                    3.21
        max:                                   53.52
        95th percentile:                       10.46
        sum:                               479728.50

Threads fairness:
    events (avg/stddev):           9342.6250/95.81
    execution time (avg/stddev):   29.9830/0.01

WARNING: the --test option is deprecated. You can pass a script n
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```

The following table shows the performance evaluations for test case scenario.

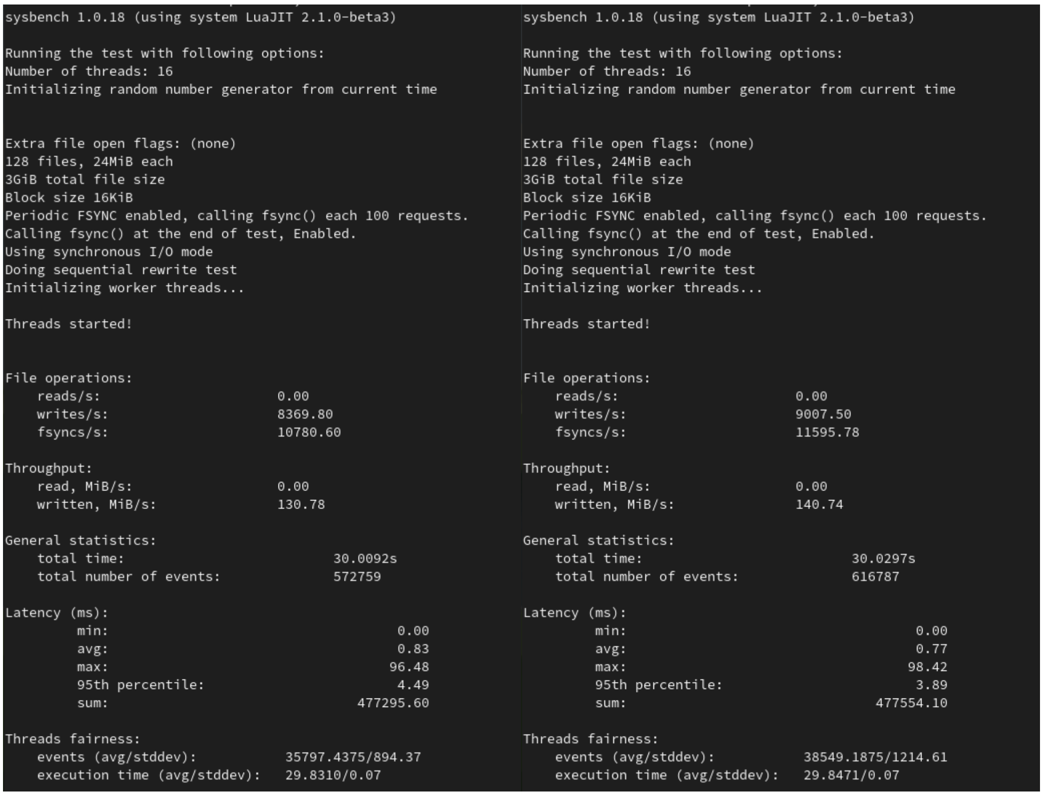
Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
1	1268.01	845.23	2772.79	19.81	13.21
2	1307.25	871.78	2856.65	20.43	13.62

Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
3	1363.35	908.84	2975.71	21.30	14.20
4	1343.62	895.58	2933.65	20.99	13.99
5	1303.92	869.67	2847.20	20.37	13.59
Average values	1317.23	878.22	2877.2	20.57	13.71

Scenario - 1 & Testcase - 5

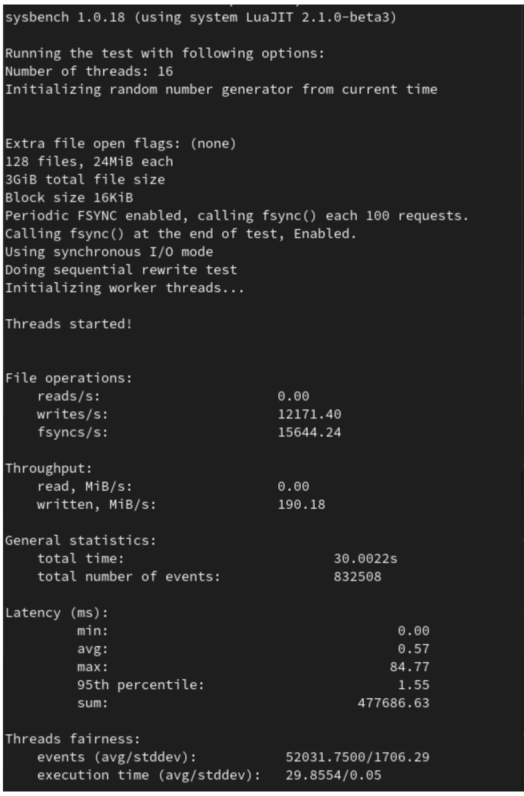
These screenshots depict five iterations of testcase 5 in scenario 1 in QEMU VM

```
#scenario-1 : 2 GiB of RAM allocated with kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img -accel kvm
#test-case-05-io-seqrewr
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr cleanup
```

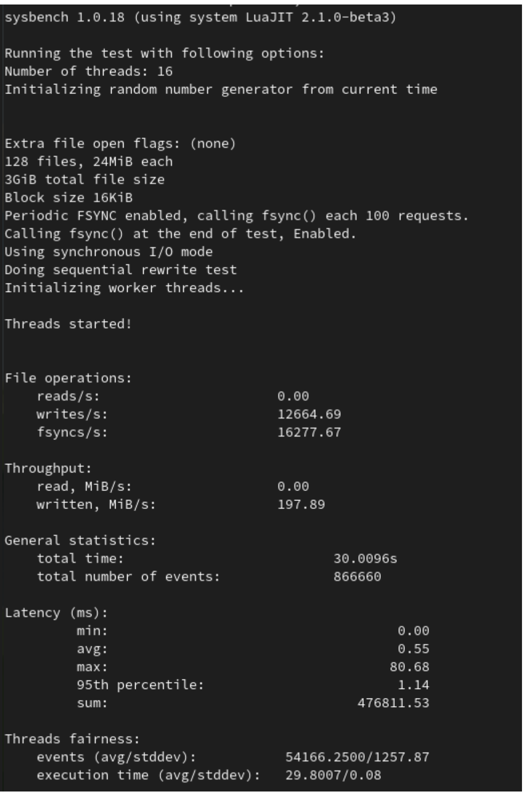


```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     8369.80
    fsyncs/s:                     10780.60

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               130.78

General statistics:
    total time:                          30.0092s
    total number of events:              572759

Latency (ms):
         min:                                    0.00
         avg:                                    0.83
         max:                                   96.48
         95th percentile:                        4.49
         sum:                               477295.60

Threads fairness:
    events (avg/stddev):           35797.4375/894.37
    execution time (avg/stddev):   29.8310/0.07
```

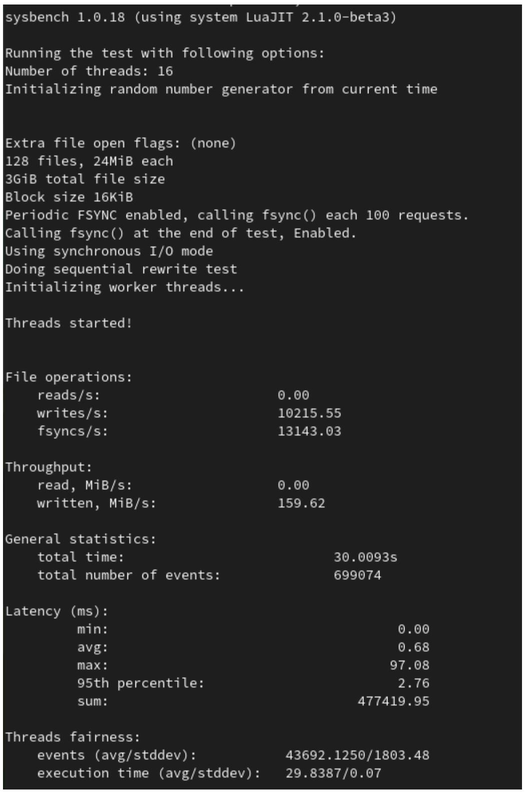
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     9007.50
    fsyncs/s:                     11595.78

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               140.74

General statistics:
    total time:                          30.0297s
    total number of events:              616787

Latency (ms):
         min:                                    0.00
         avg:                                    0.77
         max:                                   98.42
         95th percentile:                        3.89
         sum:                               477554.10

Threads fairness:
    events (avg/stddev):           38549.1875/1214.61
    execution time (avg/stddev):   29.8471/0.07
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     12171.40
    fsyncs/s:                     15644.24

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               190.18

General statistics:
    total time:                          30.0022s
    total number of events:              832508

Latency (ms):
         min:                                    0.00
         avg:                                    0.57
         max:                                   84.77
         95th percentile:                        1.55
         sum:                               477686.63

Threads fairness:
    events (avg/stddev):           52031.7500/1706.29
    execution time (avg/stddev):   29.8554/0.05
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     12664.69
    fsyncs/s:                     16277.67

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               197.89

General statistics:
    total time:                          30.0096s
    total number of events:              866660

Latency (ms):
         min:                                    0.00
         avg:                                    0.55
         max:                                   80.68
         95th percentile:                        1.14
         sum:                               476811.53

Threads fairness:
    events (avg/stddev):           54166.2500/1257.87
    execution time (avg/stddev):   29.8007/0.08
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     10215.55
    fsyncs/s:                     13143.03

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               159.62

General statistics:
    total time:                          30.0093s
    total number of events:              699074

Latency (ms):
         min:                                    0.00
         avg:                                    0.68
         max:                                   97.08
         95th percentile:                        2.76
         sum:                               477419.95

Threads fairness:
    events (avg/stddev):           43692.1250/1803.48
    execution time (avg/stddev):   29.8387/0.07
```

The following table shows the performance evaluations for test case scenario.

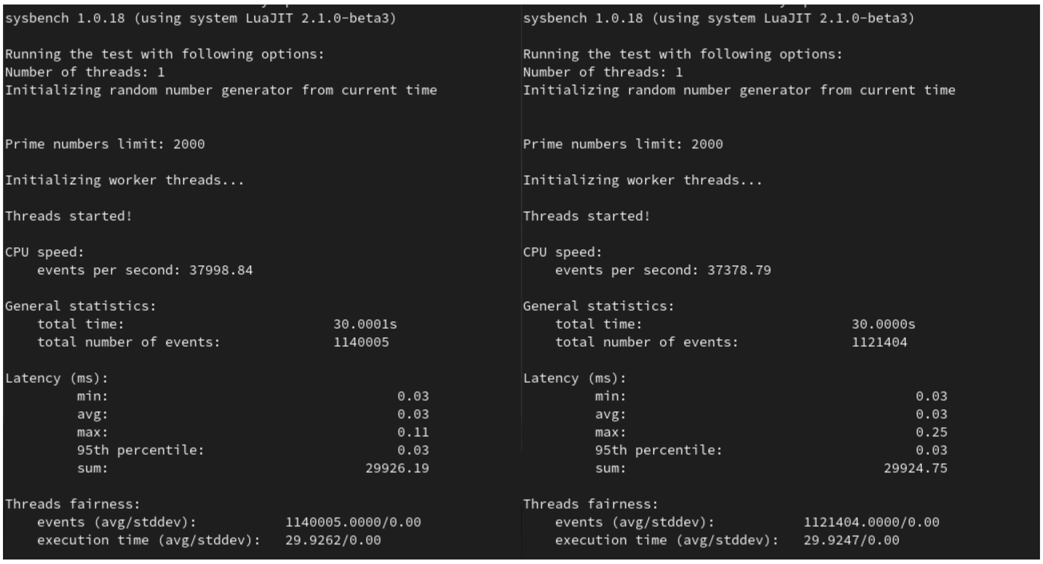
Iteration	writes/s	fsyncs/s	Throughput (written)
1	6165.17	7958.97	96.33
2	6216.73	8022.13	97.14

Iteration	writes/s	fsyncs/s	Throughput (written)
3	6148.91	7934.55	96.08
4	5681.68	7336.67	88.78
5	6163.76	7954.70	96.31
average values	6075.25	7841.4	93.76

Scenario - 2 & Testcase - 1

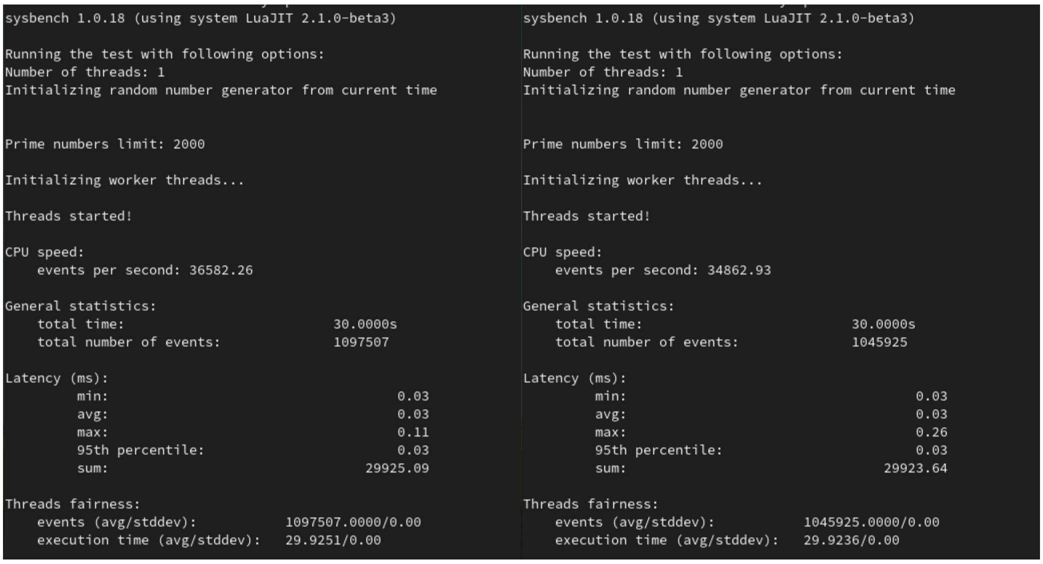
These screenshots depict five iterations of testcase 1 in scenario 2 in QEMU VM

```
#scenario-2 : 2 GiB of RAM allocated without kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img
#test-case-01-cpu-2000
sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
```



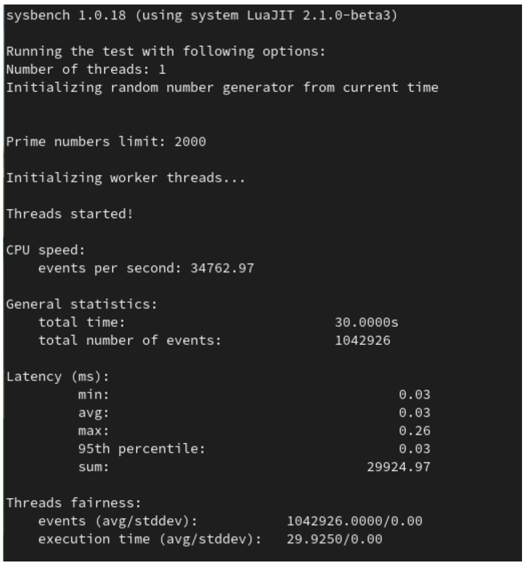
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37998.84

General statistics:
    total time:                          30.0001s
    total number of events:              1140005

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.11
         95th percentile:                        0.03
         sum:                                29926.19

Threads fairness:
    events (avg/stddev):           1140005.0000/0.00
    execution time (avg/stddev):   29.9262/0.00
```

```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37378.79

General statistics:
    total time:                          30.0000s
    total number of events:              1121404

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.25
         95th percentile:                        0.03
         sum:                                29924.75

Threads fairness:
    events (avg/stddev):           1121404.0000/0.00
    execution time (avg/stddev):   29.9247/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 36582.26

General statistics:
    total time:                          30.0000s
    total number of events:              1097507

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.11
         95th percentile:                        0.03
         sum:                                29925.09

Threads fairness:
    events (avg/stddev):           1097507.0000/0.00
    execution time (avg/stddev):   29.9251/0.00
```

```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34862.93

General statistics:
    total time:                          30.0000s
    total number of events:              1045925

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.26
         95th percentile:                        0.03
         sum:                                29923.64

Threads fairness:
    events (avg/stddev):           1045925.0000/0.00
    execution time (avg/stddev):   29.9236/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34762.97

General statistics:
    total time:                          30.0000s
    total number of events:              1042926

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.26
         95th percentile:                        0.03
         sum:                                29924.97

Threads fairness:
    events (avg/stddev):           1042926.0000/0.00
    execution time (avg/stddev):   29.9250/0.00
```

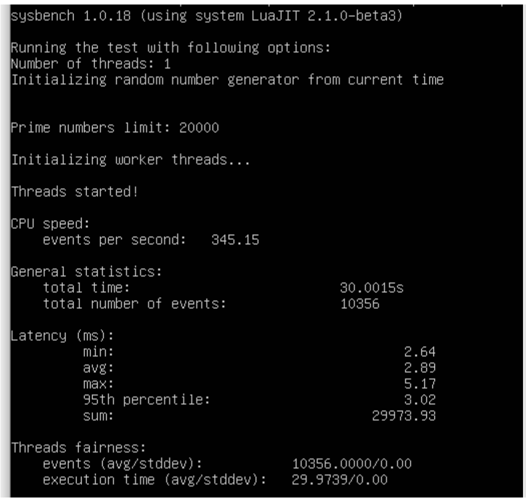
The following table shows the Events per second for test case scenario.

Iteration	**Events per second**
1	6851.15 (**MAX**)
2	6839.86
3	6845.34
4	6819.65
5	6459.04 (**MIN**)
Average Events per second	6763

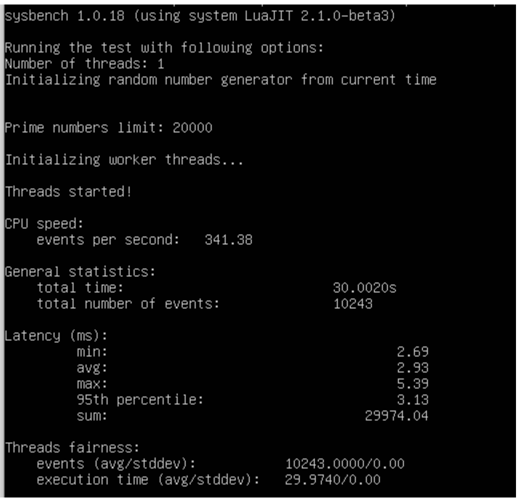
Scenario - 2 & Testcase - 2

These screenshots depict five iterations of testcase 2 in scenario 2 in QEMU VM

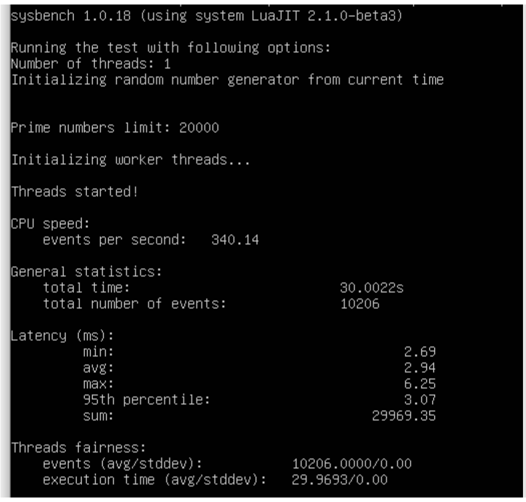
```
#scenario-2 : 2 GiB of RAM allocated without kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img
#test-case-02-cpu-20000
sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
```



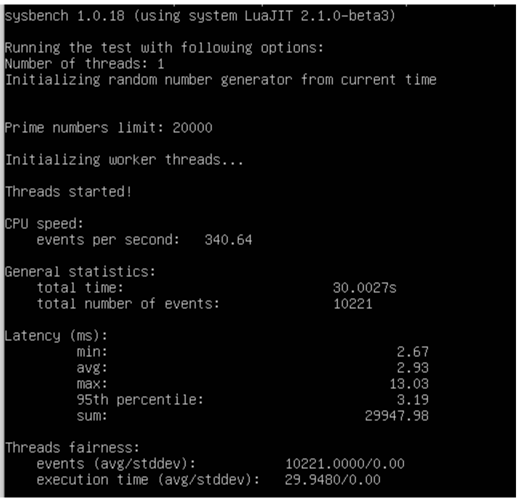
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   345.15

General statistics:
    total time:                          30.0015s
    total number of events:              10356

Latency (ms):
         min:                                    2.64
         avg:                                    2.89
         max:                                    5.17
         95th percentile:                        3.02
         sum:                                29973.93

Threads fairness:
    events (avg/stddev):           10356.0000/0.00
    execution time (avg/stddev):   29.9739/0.00
```



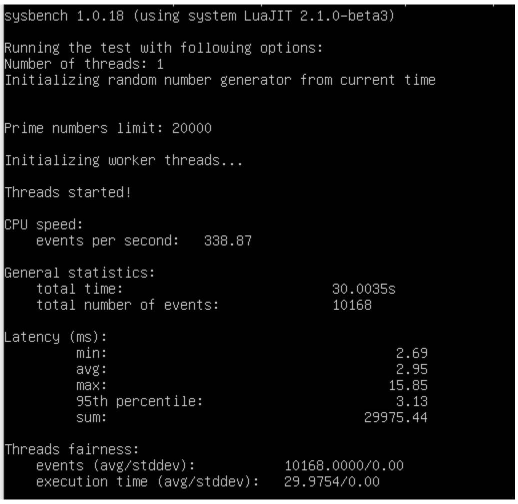
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   341.38

General statistics:
    total time:                          30.0020s
    total number of events:              10243

Latency (ms):
         min:                                    2.69
         avg:                                    2.93
         max:                                    5.39
         95th percentile:                        3.13
         sum:                                29974.04

Threads fairness:
    events (avg/stddev):           10243.0000/0.00
    execution time (avg/stddev):   29.9740/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   340.14

General statistics:
    total time:                          30.0022s
    total number of events:              10206

Latency (ms):
         min:                                    2.69
         avg:                                    2.94
         max:                                    6.25
         95th percentile:                        3.07
         sum:                                29969.35

Threads fairness:
    events (avg/stddev):           10206.0000/0.00
    execution time (avg/stddev):   29.9693/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   340.64

General statistics:
    total time:                          30.0027s
    total number of events:              10221

Latency (ms):
         min:                                    2.67
         avg:                                    2.93
         max:                                   13.03
         95th percentile:                        3.19
         sum:                                29947.98

Threads fairness:
    events (avg/stddev):           10221.0000/0.00
    execution time (avg/stddev):   29.9480/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   338.87

General statistics:
    total time:                          30.0035s
    total number of events:              10168

Latency (ms):
         min:                                    2.69
         avg:                                    2.95
         max:                                   15.85
         95th percentile:                        3.13
         sum:                                29975.44

Threads fairness:
    events (avg/stddev):           10168.0000/0.00
    execution time (avg/stddev):   29.9754/0.00
```

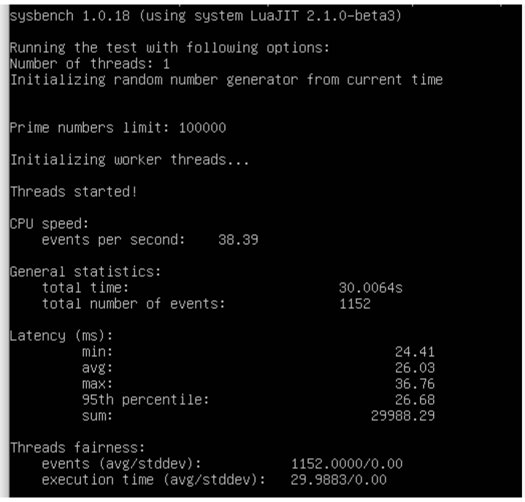
The following table shows the Events per second for test case scenario.

Iteration	**Events per second**
1	345.15 (**MAX**)
2	341.38
3	340.14
4	340.64
5	338.87 (**MIN**)
Average Events per second	341.23

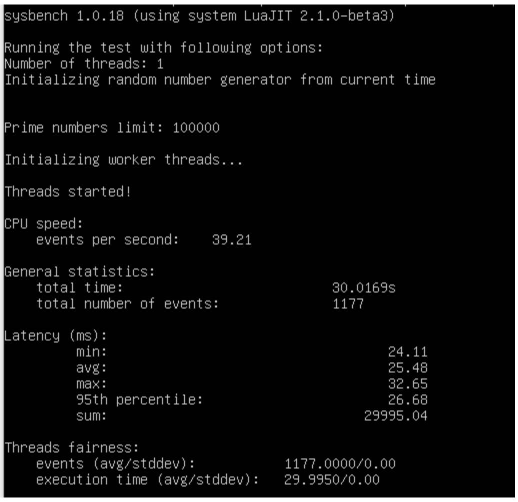
Scenario - 2 & Testcase - 3

These screenshots depict five iterations of testcase 3 in scenario 2 in QEMU VM

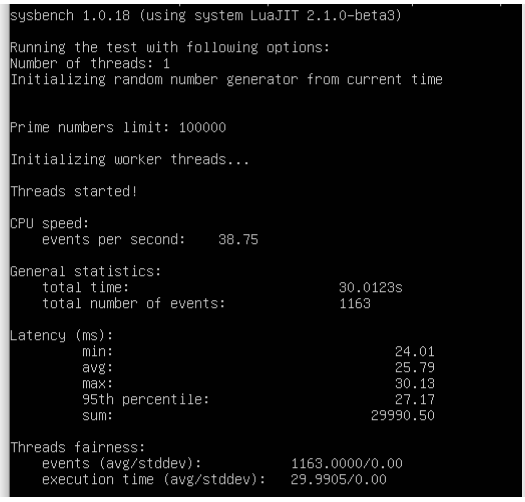
```
#scenario-2 : 2 GiB of RAM allocated without kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img
#test-case-03-cpu-100000
sysbench --test=cpu --cpu-max-prime=100000 --time=30 run
```



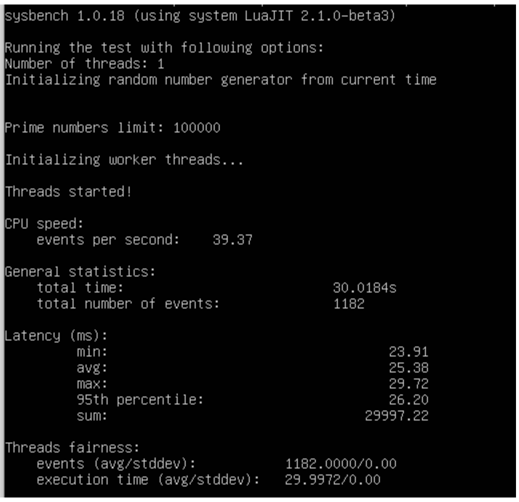
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:    38.39

General statistics:
    total time:                          30.0064s
    total number of events:              1152

Latency (ms):
         min:                                   24.41
         avg:                                   26.03
         max:                                   36.76
         95th percentile:                       26.68
         sum:                                29988.29

Threads fairness:
    events (avg/stddev):           1152.0000/0.00
    execution time (avg/stddev):   29.9883/0.00
```



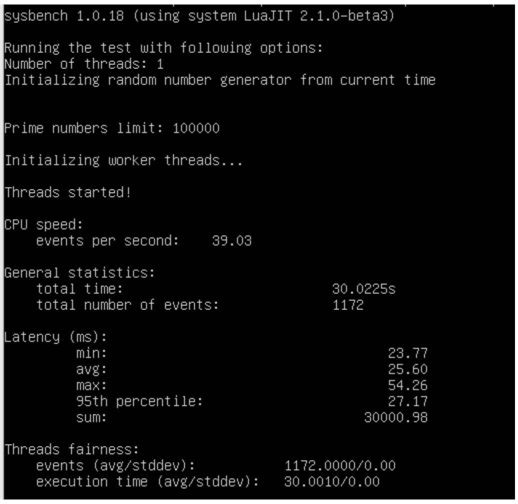
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:    39.21

General statistics:
    total time:                          30.0169s
    total number of events:              1177

Latency (ms):
         min:                                   24.11
         avg:                                   25.48
         max:                                   32.65
         95th percentile:                       26.68
         sum:                                29995.04

Threads fairness:
    events (avg/stddev):           1177.0000/0.00
    execution time (avg/stddev):   29.9950/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:    38.75

General statistics:
    total time:                          30.0123s
    total number of events:              1163

Latency (ms):
         min:                                   24.01
         avg:                                   25.79
         max:                                   30.13
         95th percentile:                       27.17
         sum:                                29990.50

Threads fairness:
    events (avg/stddev):           1163.0000/0.00
    execution time (avg/stddev):   29.9905/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:    39.37

General statistics:
    total time:                          30.0184s
    total number of events:              1182

Latency (ms):
         min:                                   23.91
         avg:                                   25.38
         max:                                   29.72
         95th percentile:                       26.20
         sum:                                29997.22

Threads fairness:
    events (avg/stddev):           1182.0000/0.00
    execution time (avg/stddev):   29.9972/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:    39.03

General statistics:
    total time:                          30.0225s
    total number of events:              1172

Latency (ms):
         min:                                   23.77
         avg:                                   25.60
         max:                                   54.26
         95th percentile:                       27.17
         sum:                                30000.98

Threads fairness:
    events (avg/stddev):           1172.0000/0.00
    execution time (avg/stddev):   30.0010/0.00
```

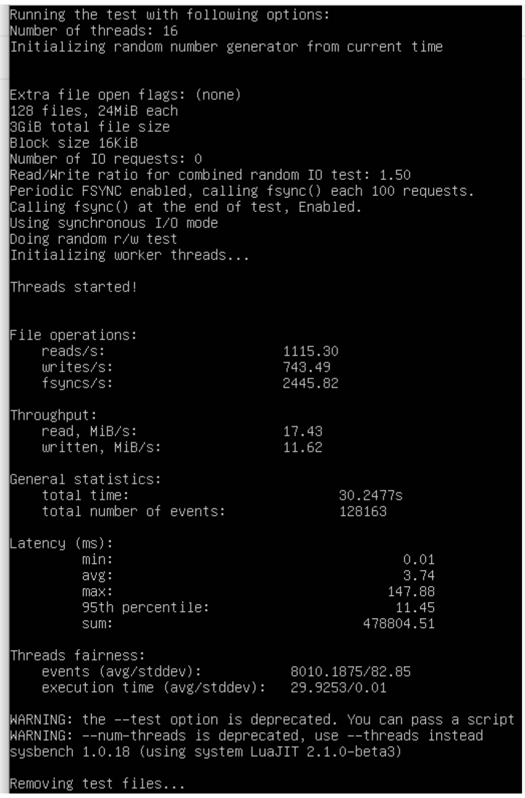
The following table shows the Events per second for test case scenario.

Iteration	**Events per second**
1	38.39
2	39.21
3	38.75 (**MAX**)
4	39.37 (**MIN**)
5	39.03
Average Events per second	38.95

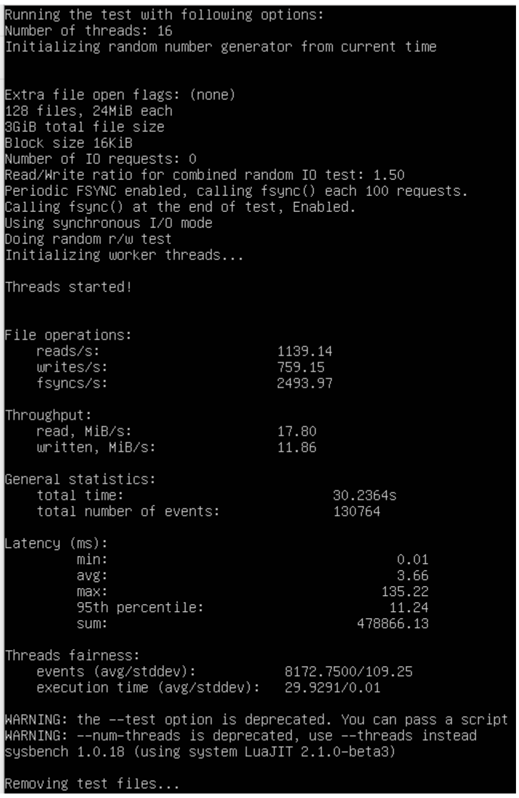
Scenario - 2 & Testcase - 4

These screenshots depict five iterations of testcase 4 in scenario 2 in QEMU VM

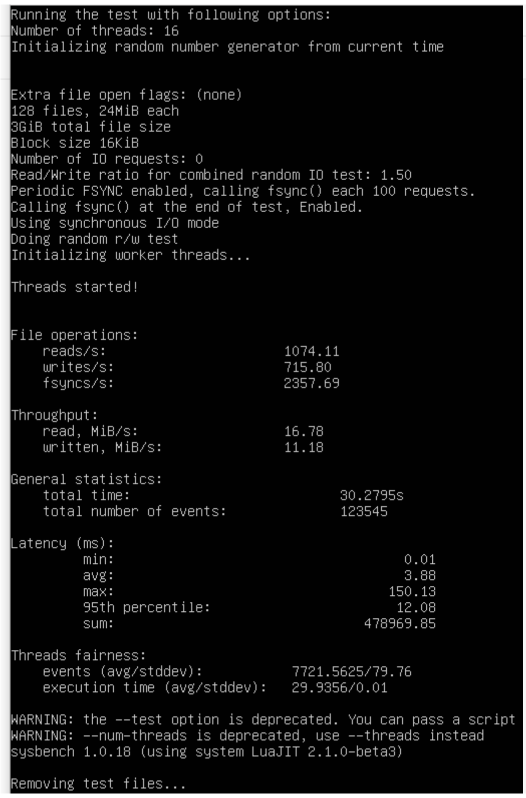
```
#scenario-2 : 2 GiB of RAM allocated without kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img
#test-case-04-io-rndrw
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw cleanup
```



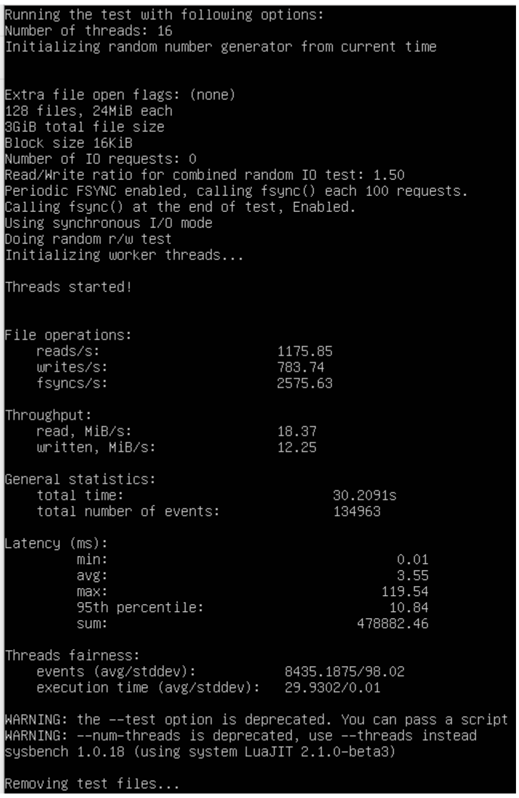
```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1115.30
    writes/s:                     743.49
    fsyncs/s:                     2445.82

Throughput:
    read, MiB/s:                  17.43
    written, MiB/s:               11.62

General statistics:
    total time:                          30.2477s
    total number of events:              128163

Latency (ms):
         min:                                    0.01
         avg:                                    3.74
         max:                                  147.88
         95th percentile:                       11.45
         sum:                               478804.51

Threads fairness:
    events (avg/stddev):           8010.1875/82.85
    execution time (avg/stddev):   29.9253/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



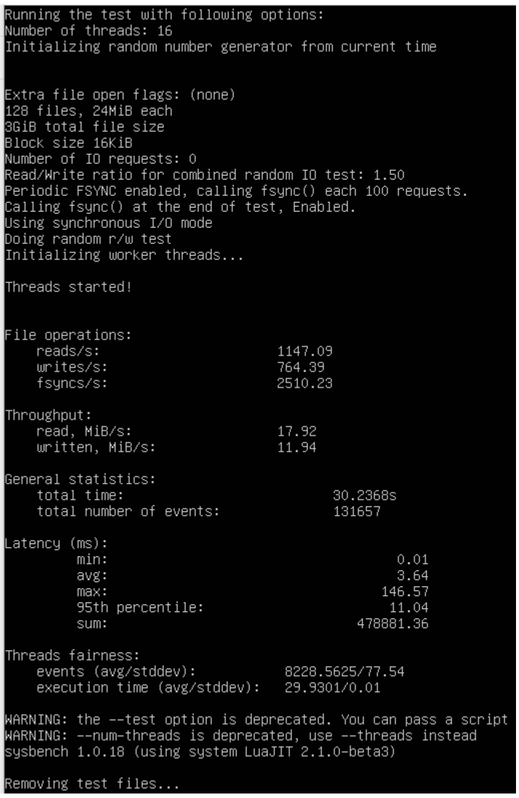
```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1139.14
    writes/s:                     759.15
    fsyncs/s:                     2493.97

Throughput:
    read, MiB/s:                  17.80
    written, MiB/s:               11.86

General statistics:
    total time:                          30.2364s
    total number of events:              130764

Latency (ms):
         min:                                    0.01
         avg:                                    3.66
         max:                                  135.22
         95th percentile:                       11.24
         sum:                               478866.13

Threads fairness:
    events (avg/stddev):           8172.7500/109.25
    execution time (avg/stddev):   29.9291/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1074.11
    writes/s:                     715.80
    fsyncs/s:                     2357.69

Throughput:
    read, MiB/s:                  16.78
    written, MiB/s:               11.18

General statistics:
    total time:                          30.2795s
    total number of events:              123545

Latency (ms):
         min:                                    0.01
         avg:                                    3.88
         max:                                  150.13
         95th percentile:                       12.08
         sum:                               478969.85

Threads fairness:
    events (avg/stddev):           7721.5625/79.76
    execution time (avg/stddev):   29.9356/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1175.85
    writes/s:                     783.74
    fsyncs/s:                     2575.63

Throughput:
    read, MiB/s:                  18.37
    written, MiB/s:               12.25

General statistics:
    total time:                          30.2091s
    total number of events:              134963

Latency (ms):
         min:                                    0.01
         avg:                                    3.55
         max:                                  119.54
         95th percentile:                       10.84
         sum:                               478882.46

Threads fairness:
    events (avg/stddev):           8435.1875/98.02
    execution time (avg/stddev):   29.9302/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1147.09
    writes/s:                     764.39
    fsyncs/s:                     2510.23

Throughput:
    read, MiB/s:                  17.92
    written, MiB/s:               11.94

General statistics:
    total time:                          30.2368s
    total number of events:              131657

Latency (ms):
         min:                                    0.01
         avg:                                    3.64
         max:                                  146.57
         95th percentile:                       11.04
         sum:                               478881.36

Threads fairness:
    events (avg/stddev):           8228.5625/77.54
    execution time (avg/stddev):   29.9301/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```

The following table shows the performance evaluations for test case scenario.

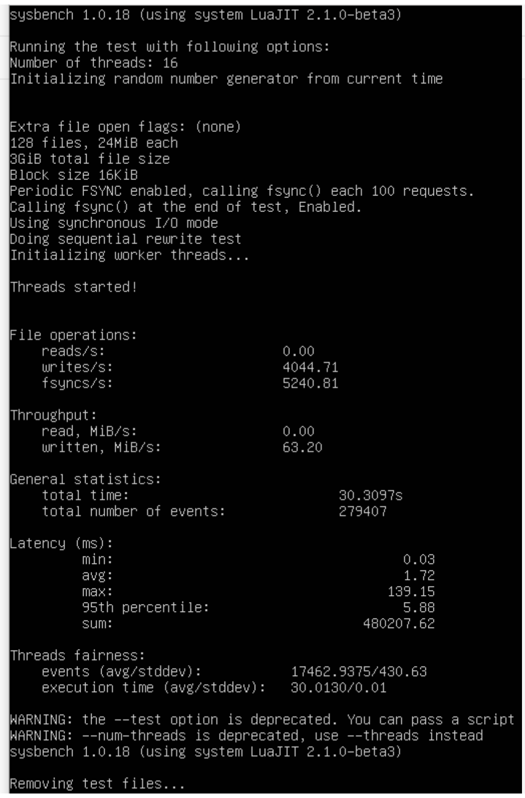
Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
1	1115.30	743.49	2445.82	17.43	11.62
2	1139.14	759.15	2493.97	17.80	11.86

Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
3	1074.11	715.80	2357.69	16.78	11.18
4	1175.85	783.74	2575.63	18.37	12.25
5	1147.09	764.39	2510.23	17.92	11.94
average values	1139.42	759.36	2481.57	17.71	11.86

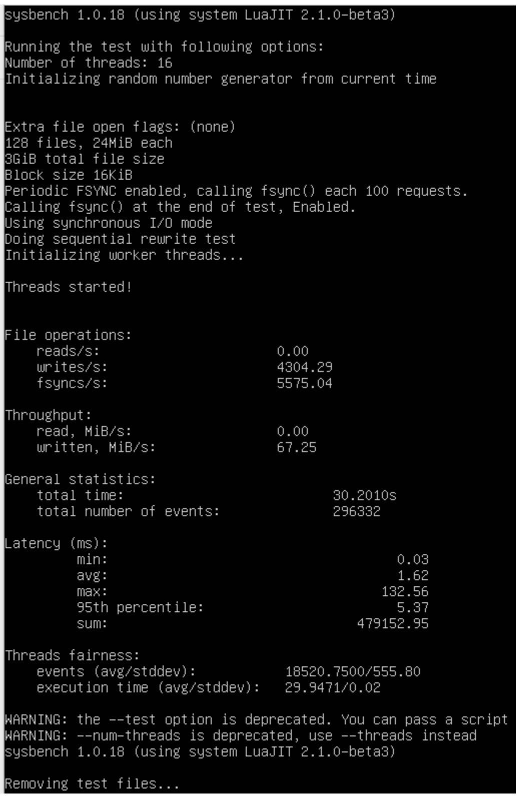
Scenario - 2 & Testcase - 5

These screenshots depict five iterations of testcase 5 in scenario 2 in QEMU VM

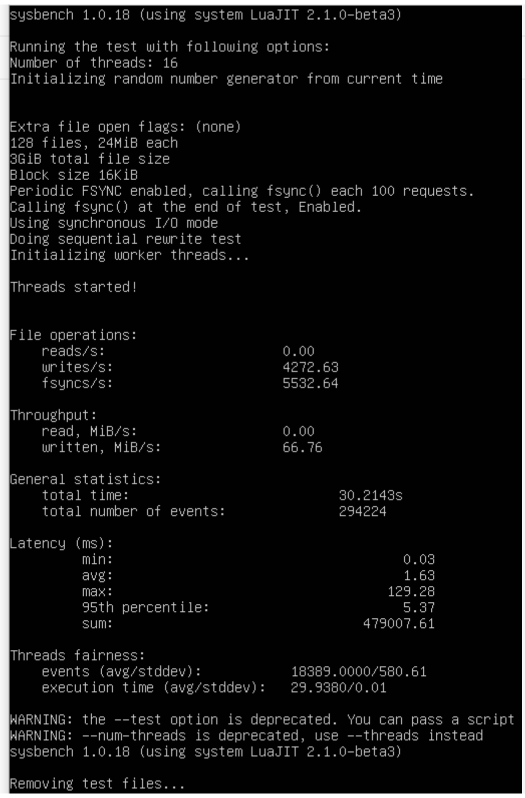
```
#scenario-2 : 2 GiB of RAM allocated without kvm accelerator
$ sudo qemu-system-x86_64 -m 2048 -hda ubuntu.img
#test-case-05-io-seqrewr
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr cleanup
```



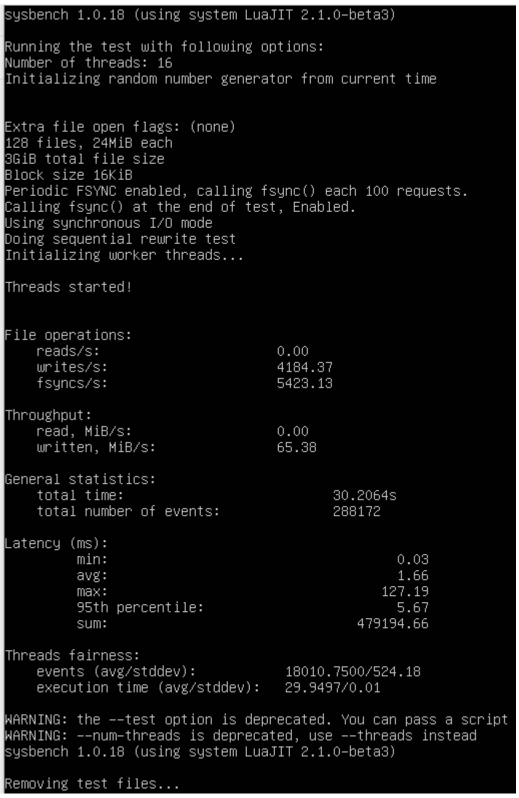
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     4044.71
    fsyncs/s:                     5240.81

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               63.20

General statistics:
    total time:                          30.3097s
    total number of events:              279407

Latency (ms):
         min:                                    0.03
         avg:                                    1.72
         max:                                  139.15
         95th percentile:                        5.88
         sum:                               480207.62

Threads fairness:
    events (avg/stddev):           17462.9375/430.63
    execution time (avg/stddev):   30.0130/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



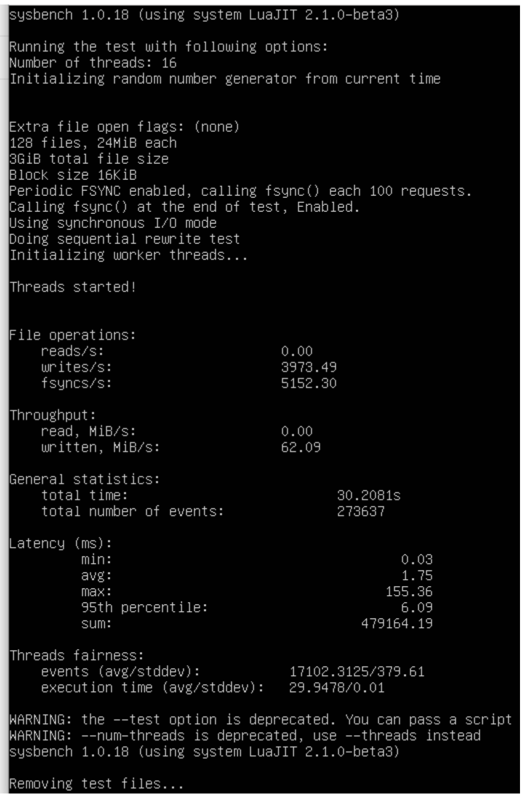
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     4304.29
    fsyncs/s:                     5575.04

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               67.25

General statistics:
    total time:                          30.2010s
    total number of events:              296332

Latency (ms):
         min:                                    0.03
         avg:                                    1.62
         max:                                  132.56
         95th percentile:                        5.37
         sum:                               479152.95

Threads fairness:
    events (avg/stddev):           18520.7500/555.80
    execution time (avg/stddev):   29.9471/0.02

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     4272.63
    fsyncs/s:                     5532.64

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               66.76

General statistics:
    total time:                          30.2143s
    total number of events:              294224

Latency (ms):
         min:                                    0.03
         avg:                                    1.63
         max:                                  129.28
         95th percentile:                        5.37
         sum:                               479007.61

Threads fairness:
    events (avg/stddev):           18389.0000/580.61
    execution time (avg/stddev):   29.9380/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     4184.37
    fsyncs/s:                     5423.13

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               65.38

General statistics:
    total time:                          30.2064s
    total number of events:              288172

Latency (ms):
         min:                                    0.03
         avg:                                    1.66
         max:                                  127.19
         95th percentile:                        5.67
         sum:                               479194.66

Threads fairness:
    events (avg/stddev):           18010.7500/524.18
    execution time (avg/stddev):   29.9497/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     3973.49
    fsyncs/s:                     5152.30

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               62.09

General statistics:
    total time:                          30.2081s
    total number of events:              273637

Latency (ms):
         min:                                    0.03
         avg:                                    1.75
         max:                                  155.36
         95th percentile:                        6.09
         sum:                               479164.19

Threads fairness:
    events (avg/stddev):           17102.3125/379.61
    execution time (avg/stddev):   29.9478/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```

The following table shows the performance evaluations for test case scenario.

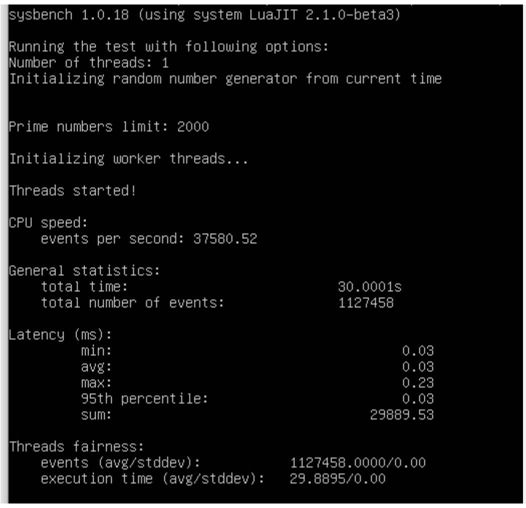
Iteration	writes/s	fsyncs/s	Throughput (written)
1	4044.71	5240.81	63.20
2	4304.29	5575.04	67.25

Iteration	writes/s	fsyncs/s	Throughput (written)
3	4272.63	5532.64	66.76
4	4184.37	5423.13	65.38
5	3973.49	5152.30	62.09
average values	4121.52	5368.68	64.36

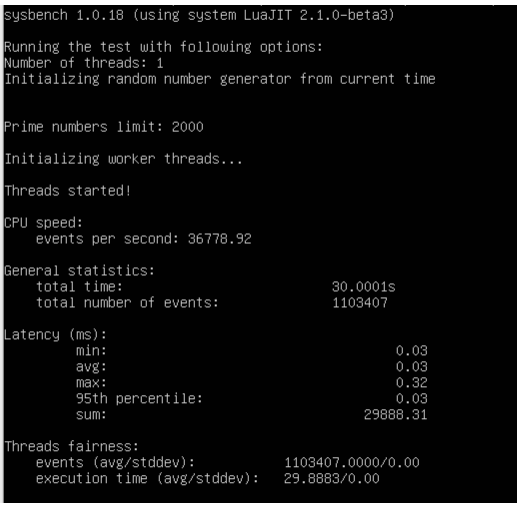
Scenario - 3 & Testcase - 1

These screenshots depict five iterations of testcase 1 in scenario 3 in QEMU VM

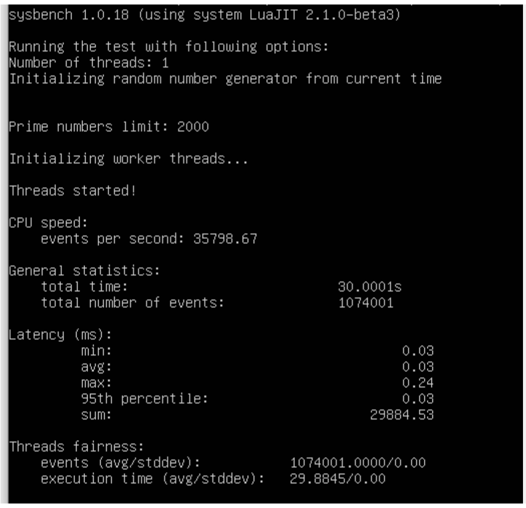
```
#scenario-3 : 8 GiB of RAM allocated with kvm accelerator and smp set to max=12
$ sudo qemu-system-x86_64 -m 8192 -hda ubuntu.img -accel kvm -smp 12
#test-case-01-cpu-2000
sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
```



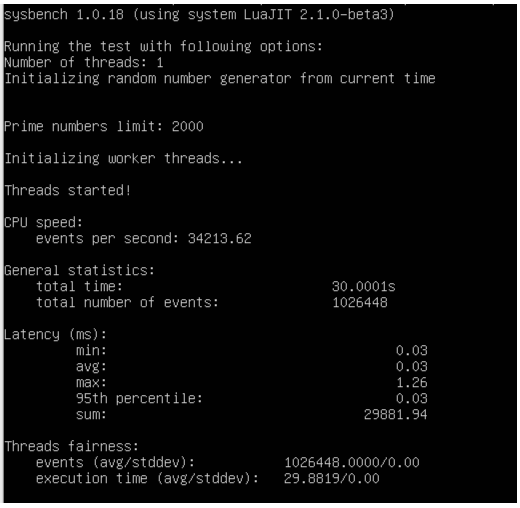
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37580.52

General statistics:
    total time:                          30.0001s
    total number of events:              1127458

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.23
         95th percentile:                        0.03
         sum:                                29889.53

Threads fairness:
    events (avg/stddev):           1127458.0000/0.00
    execution time (avg/stddev):   29.8895/0.00
```



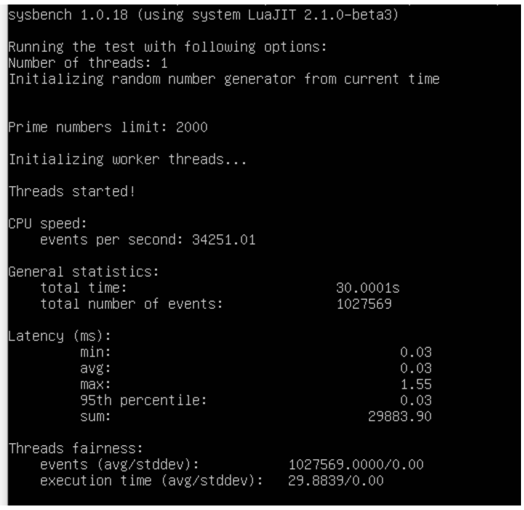
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 36778.92

General statistics:
    total time:                          30.0001s
    total number of events:              1103407

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.32
         95th percentile:                        0.03
         sum:                                29888.31

Threads fairness:
    events (avg/stddev):           1103407.0000/0.00
    execution time (avg/stddev):   29.8883/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 35798.67

General statistics:
    total time:                          30.0001s
    total number of events:              1074001

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.24
         95th percentile:                        0.03
         sum:                                29884.53

Threads fairness:
    events (avg/stddev):           1074001.0000/0.00
    execution time (avg/stddev):   29.8845/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34213.62

General statistics:
    total time:                          30.0001s
    total number of events:              1026448

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    1.26
         95th percentile:                        0.03
         sum:                                29881.94

Threads fairness:
    events (avg/stddev):           1026448.0000/0.00
    execution time (avg/stddev):   29.8819/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34251.01

General statistics:
    total time:                          30.0001s
    total number of events:              1027569

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    1.55
         95th percentile:                        0.03
         sum:                                29883.90

Threads fairness:
    events (avg/stddev):           1027569.0000/0.00
    execution time (avg/stddev):   29.8839/0.00
```

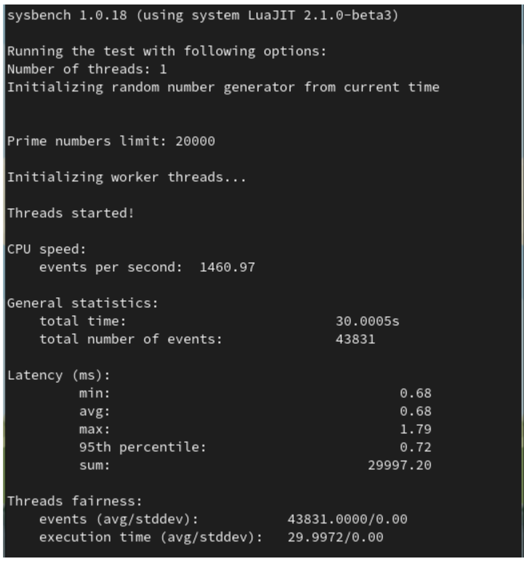
The following table shows the Events per second for test case scenario.

Iteration	**Events per second**
1	37580.52 (**MAX**)
2	36778.92
3	35798.67
4	34213.62 (**MIN**)
5	34251.01
Average Events per second	35724.55

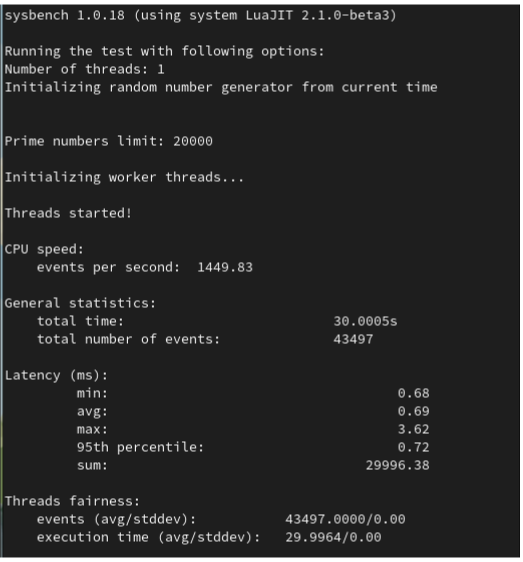
Scenario - 3 & Testcase - 2

These screenshots depict five iterations of testcase 2 in scenario 3 in QEMU VM

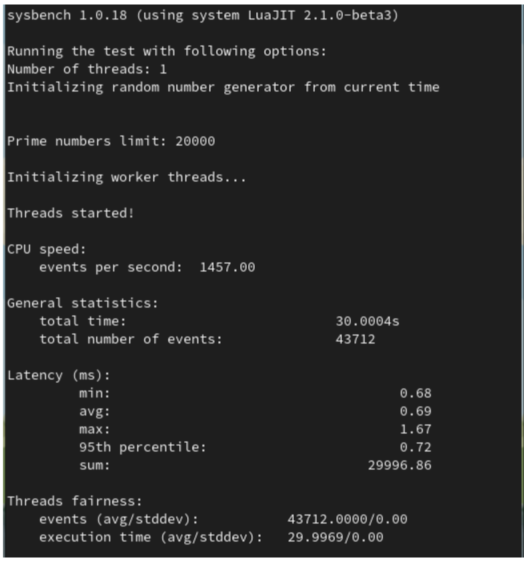
```
#scenario-3 : 8 GiB of RAM allocated with kvm accelerator and smp set to max=12
$ sudo qemu-system-x86_64 -m 8192 -hda ubuntu.img -accel kvm -smp 12
#test-case-02-cpu-20000
sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
```



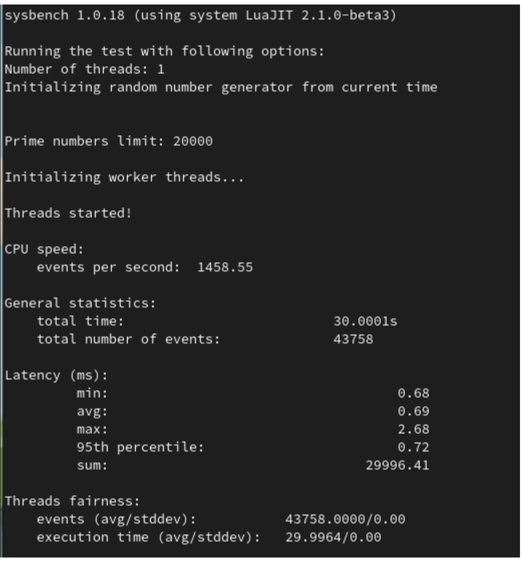
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1460.97

General statistics:
    total time:                          30.0005s
    total number of events:              43831

Latency (ms):
         min:                                    0.68
         avg:                                    0.68
         max:                                    1.79
         95th percentile:                        0.72
         sum:                                29997.20

Threads fairness:
    events (avg/stddev):           43831.0000/0.00
    execution time (avg/stddev):   29.9972/0.00
```



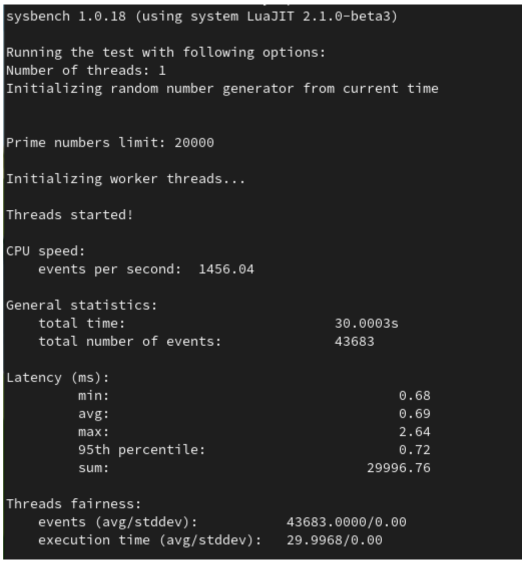
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1449.83

General statistics:
    total time:                          30.0005s
    total number of events:              43497

Latency (ms):
         min:                                    0.68
         avg:                                    0.69
         max:                                    3.62
         95th percentile:                        0.72
         sum:                                29996.38

Threads fairness:
    events (avg/stddev):           43497.0000/0.00
    execution time (avg/stddev):   29.9964/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1457.00

General statistics:
    total time:                          30.0004s
    total number of events:              43712

Latency (ms):
         min:                                    0.68
         avg:                                    0.69
         max:                                    1.67
         95th percentile:                        0.72
         sum:                                29996.86

Threads fairness:
    events (avg/stddev):           43712.0000/0.00
    execution time (avg/stddev):   29.9969/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1458.55

General statistics:
    total time:                          30.0001s
    total number of events:              43758

Latency (ms):
         min:                                    0.68
         avg:                                    0.69
         max:                                    2.68
         95th percentile:                        0.72
         sum:                                29996.41

Threads fairness:
    events (avg/stddev):           43758.0000/0.00
    execution time (avg/stddev):   29.9964/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1456.04

General statistics:
    total time:                          30.0003s
    total number of events:              43683

Latency (ms):
         min:                                    0.68
         avg:                                    0.69
         max:                                    2.64
         95th percentile:                        0.72
         sum:                                29996.76

Threads fairness:
    events (avg/stddev):           43683.0000/0.00
    execution time (avg/stddev):   29.9968/0.00
```

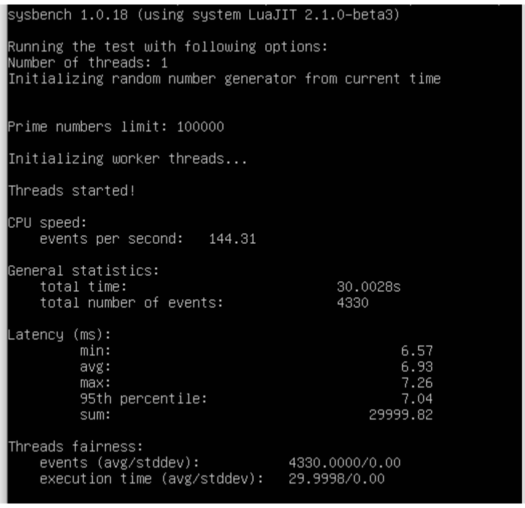
The following table shows the Events per second for test case scenario.

Iteration	Events per second
1	1324.87
2	1324.12
3	1321.18 (**MIN**)
4	1325.20 (**MAX**)
5	1324.87
Average Events per second	1323.89

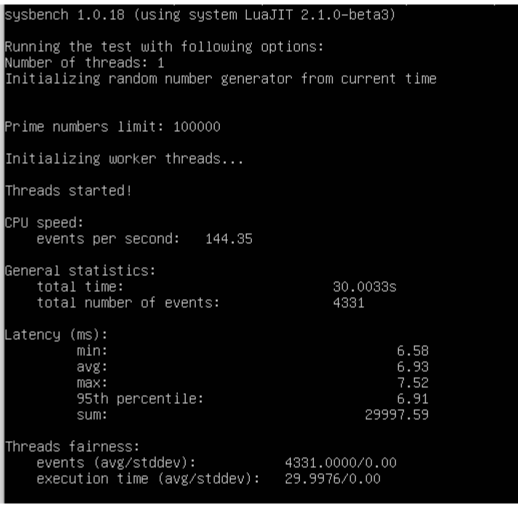
Scenario - 3 & Testcase - 3

These screenshots depict five iterations of testcase 3 in scenario 3 in QEMU VM

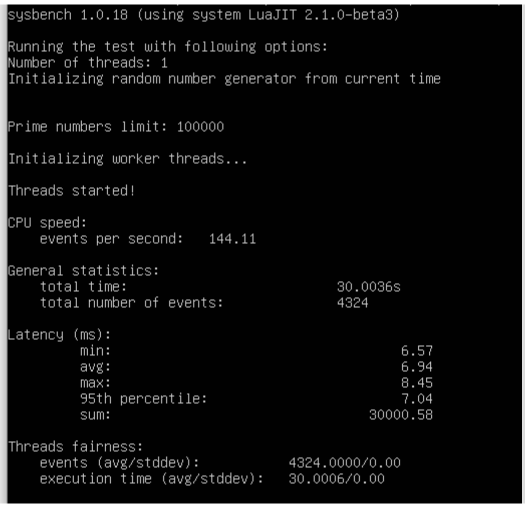
```
#scenario-3 : 8 GiB of RAM allocated with kvm accelerator and smp set to max=12
$ sudo qemu-system-x86_64 -m 8192 -hda ubuntu.img -accel kvm -smp 12
#test-case-03-cpu-100000
sysbench --test=cpu --cpu-max-prime=100000 --time=30 run
```



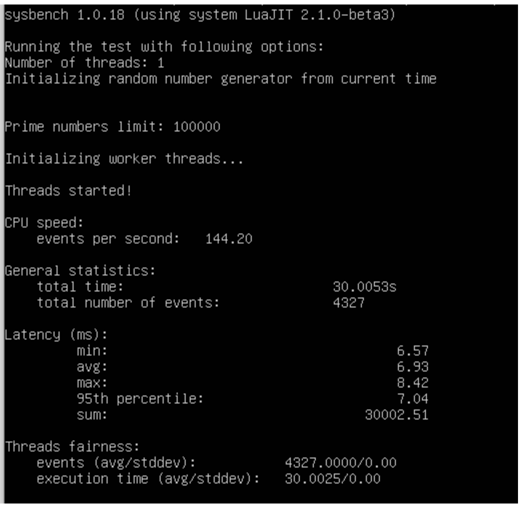
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   144.31

General statistics:
    total time:                          30.0028s
    total number of events:              4330

Latency (ms):
         min:                                    6.57
         avg:                                    6.93
         max:                                    7.26
         95th percentile:                        7.04
         sum:                                29999.82

Threads fairness:
    events (avg/stddev):           4330.0000/0.00
    execution time (avg/stddev):   29.9998/0.00
```



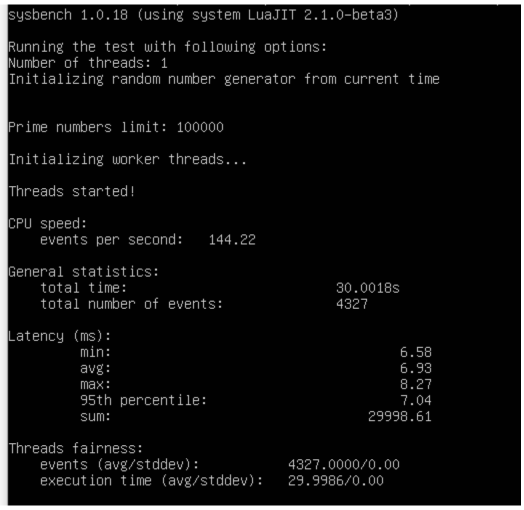
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   144.35

General statistics:
    total time:                          30.0033s
    total number of events:              4331

Latency (ms):
         min:                                    6.58
         avg:                                    6.93
         max:                                    7.52
         95th percentile:                        6.91
         sum:                                29997.59

Threads fairness:
    events (avg/stddev):           4331.0000/0.00
    execution time (avg/stddev):   29.9976/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   144.11

General statistics:
    total time:                          30.0036s
    total number of events:              4324

Latency (ms):
         min:                                    6.57
         avg:                                    6.94
         max:                                    8.45
         95th percentile:                        7.04
         sum:                                30000.58

Threads fairness:
    events (avg/stddev):           4324.0000/0.00
    execution time (avg/stddev):   30.0006/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   144.20

General statistics:
    total time:                          30.0053s
    total number of events:              4327

Latency (ms):
         min:                                    6.57
         avg:                                    6.93
         max:                                    8.42
         95th percentile:                        7.04
         sum:                                30002.51

Threads fairness:
    events (avg/stddev):           4327.0000/0.00
    execution time (avg/stddev):   30.0025/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   144.22

General statistics:
    total time:                          30.0018s
    total number of events:              4327

Latency (ms):
         min:                                    6.58
         avg:                                    6.93
         max:                                    8.27
         95th percentile:                        7.04
         sum:                                29998.61

Threads fairness:
    events (avg/stddev):           4327.0000/0.00
    execution time (avg/stddev):   29.9986/0.00
```

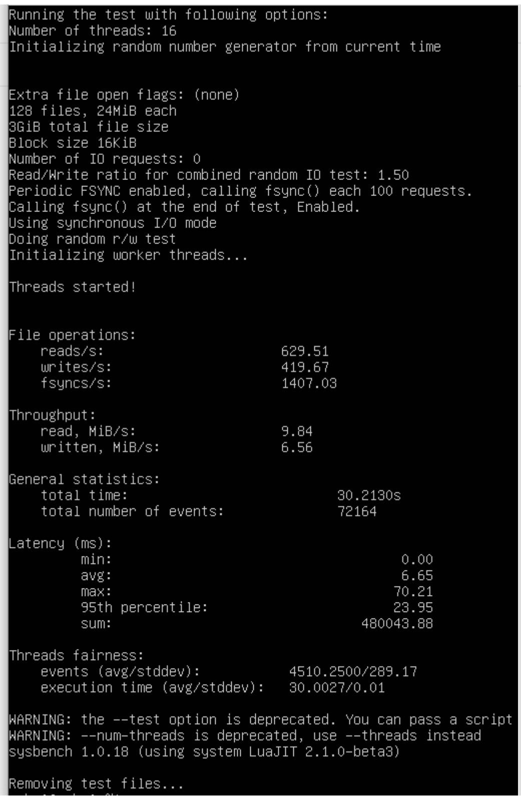
The following table shows the Events per second for test case scenario.

Iteration	Events per second
1	144.31
2	144.35 (**MAX**)
3	144.11 (**MIN**)
4	144.20
5	144.22
Average Events per second	144.24

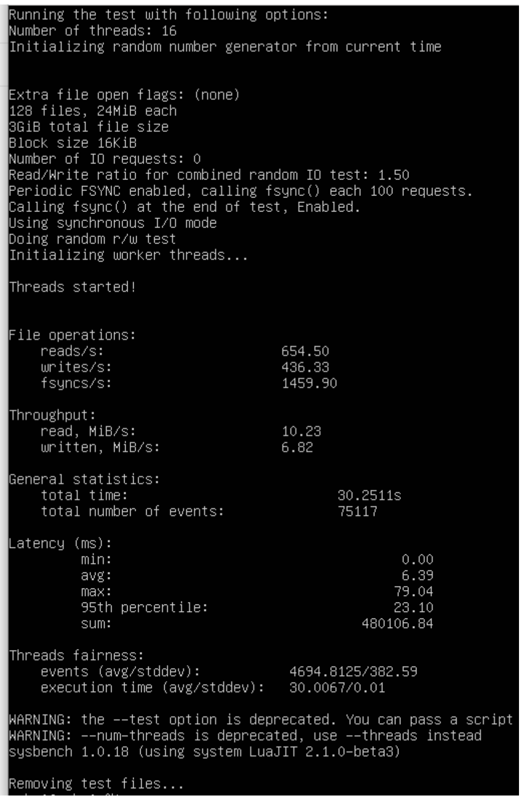
Scenario - 3 & Testcase - 4

These screenshots depict five iterations of testcase 4 in scenario 3 in QEMU VM

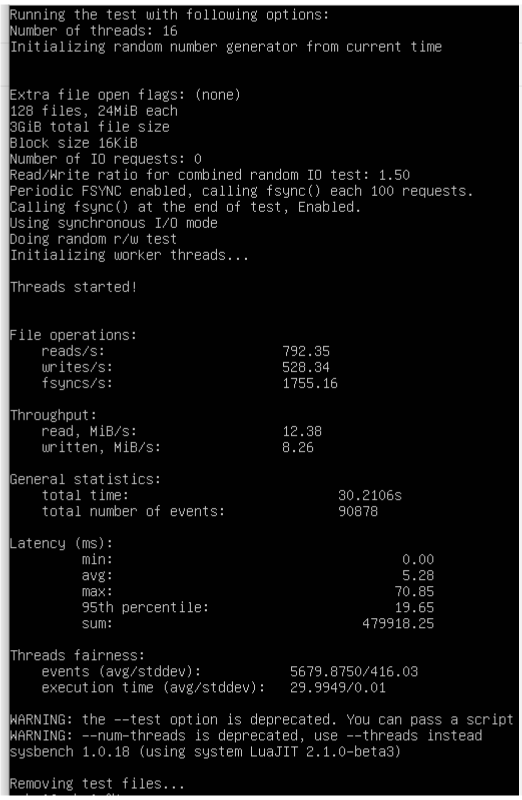
```
#scenario-3 : 8 GiB of RAM allocated with kvm accelerator and smp set to max=12
$ sudo qemu-system-x86_64 -m 8192 -hda ubuntu.img -accel kvm -smp 12
#test-case-04-io-rndrw
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw cleanup
```



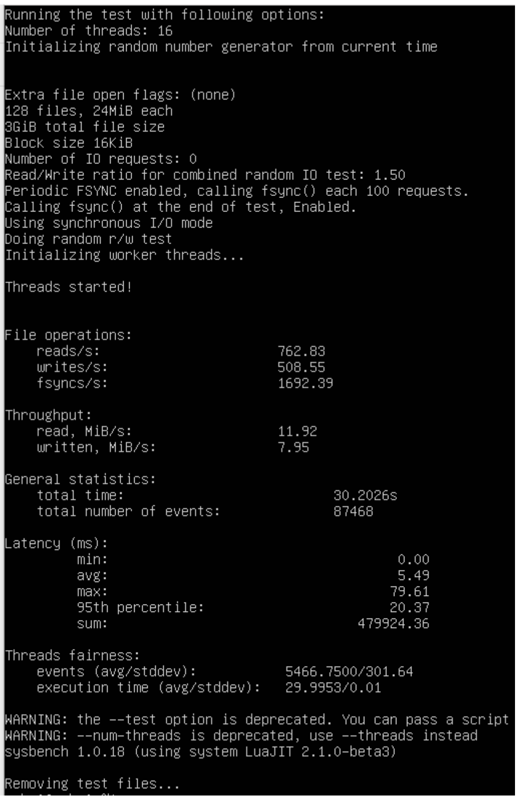
```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      629.51
    writes/s:                     419.67
    fsyncs/s:                     1407.03

Throughput:
    read, MiB/s:                  9.84
    written, MiB/s:               6.56

General statistics:
    total time:                          30.2130s
    total number of events:              72164

Latency (ms):
         min:                                    0.00
         avg:                                    6.65
         max:                                   70.21
         95th percentile:                       23.95
         sum:                               480043.88

Threads fairness:
    events (avg/stddev):           4510.2500/289.17
    execution time (avg/stddev):   30.0027/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



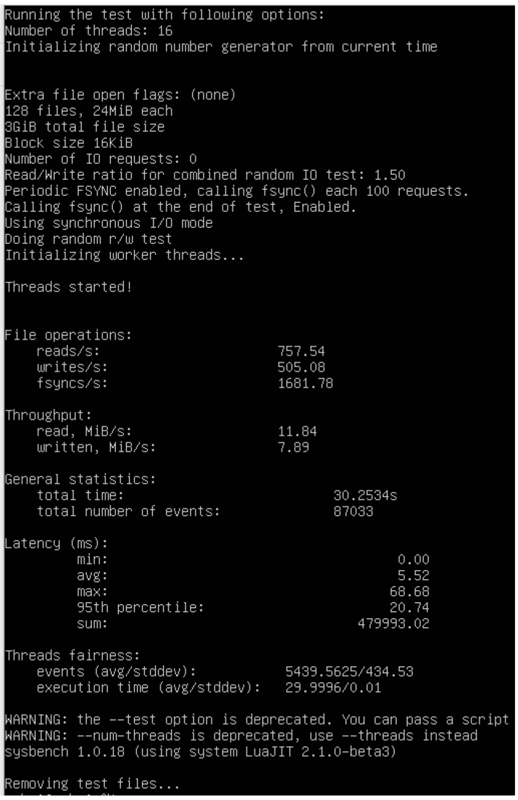
```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      654.50
    writes/s:                     436.33
    fsyncs/s:                     1459.90

Throughput:
    read, MiB/s:                  10.23
    written, MiB/s:               6.82

General statistics:
    total time:                          30.2511s
    total number of events:              75117

Latency (ms):
         min:                                    0.00
         avg:                                    6.39
         max:                                   79.04
         95th percentile:                       23.10
         sum:                               480106.84

Threads fairness:
    events (avg/stddev):           4694.8125/382.59
    execution time (avg/stddev):   30.0067/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      792.35
    writes/s:                     528.34
    fsyncs/s:                     1755.16

Throughput:
    read, MiB/s:                  12.38
    written, MiB/s:               8.26

General statistics:
    total time:                          30.2106s
    total number of events:              90878

Latency (ms):
         min:                                    0.00
         avg:                                    5.28
         max:                                   70.85
         95th percentile:                       19.65
         sum:                               479918.25

Threads fairness:
    events (avg/stddev):           5679.8750/416.03
    execution time (avg/stddev):   29.9949/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      762.83
    writes/s:                     508.55
    fsyncs/s:                     1692.39

Throughput:
    read, MiB/s:                  11.92
    written, MiB/s:               7.95

General statistics:
    total time:                          30.2026s
    total number of events:              87468

Latency (ms):
         min:                                    0.00
         avg:                                    5.49
         max:                                   79.61
         95th percentile:                       20.37
         sum:                               479924.36

Threads fairness:
    events (avg/stddev):           5466.7500/301.64
    execution time (avg/stddev):   29.9953/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```



```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      757.54
    writes/s:                     505.08
    fsyncs/s:                     1681.78

Throughput:
    read, MiB/s:                  11.84
    written, MiB/s:               7.89

General statistics:
    total time:                          30.2534s
    total number of events:              87033

Latency (ms):
         min:                                    0.00
         avg:                                    5.52
         max:                                   68.68
         95th percentile:                       20.74
         sum:                               479993.02

Threads fairness:
    events (avg/stddev):           5439.5625/434.53
    execution time (avg/stddev):   29.9996/0.01

WARNING: the --test option is deprecated. You can pass a script
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
```

The following table shows the performance evaluations for test case scenario.

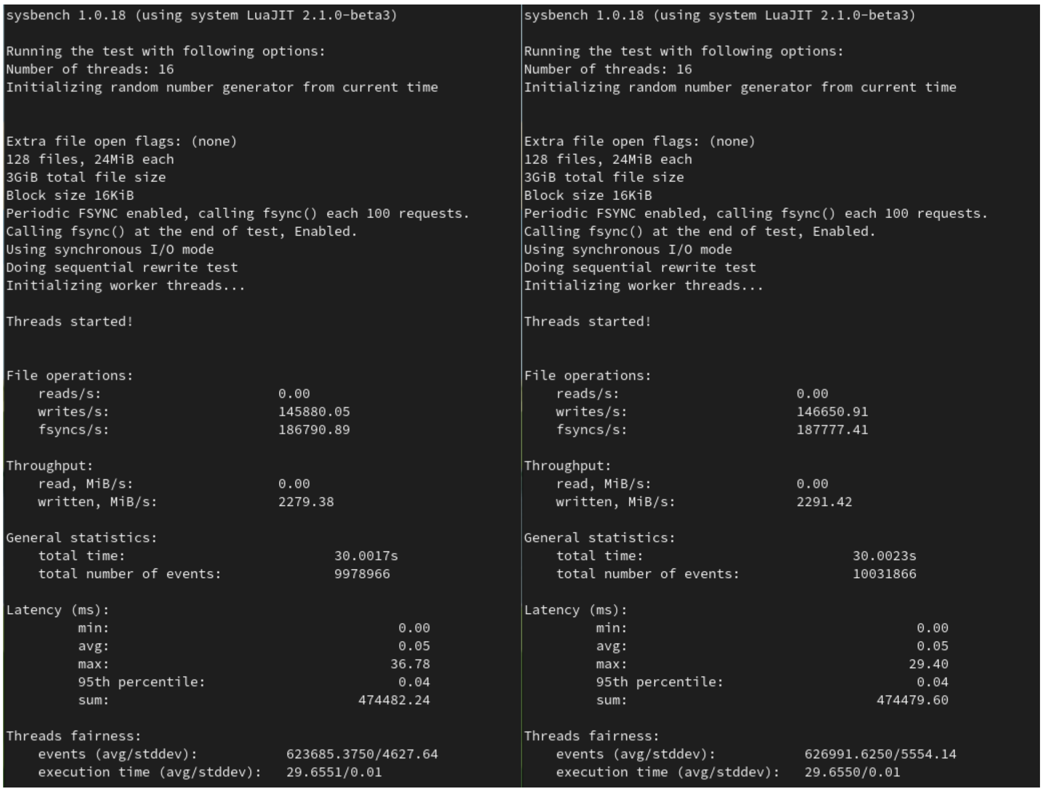
Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
1	629.51	419.67	1407.03	9.84	6.56
2	654.50	436.33	1459.90	10.23	6.82

Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
3	792.35	528.34	1755.16	12.38	8.26
4	762.83	508.55	1692.39	11.92	7.95
5	757.54	505.08	1681.78	11.84	7.89
average values	719.98	492.17	1592.25	11.05	7.45

Scenario - 3 & Testcase - 5

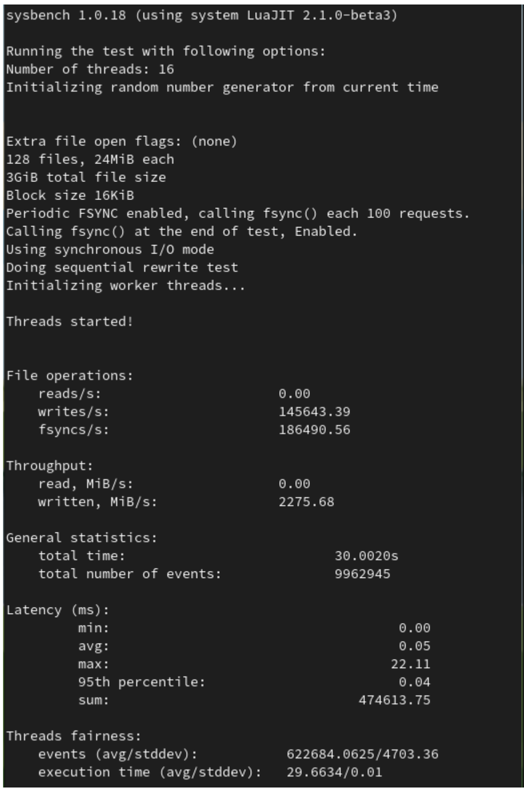
These screenshots depict five iterations of testcase 5 in scenario 3 in QEMU VM

```
#scenario-3 : 8 GiB of RAM allocated with kvm accelerator and smp set to max=12
$ sudo qemu-system-x86_64 -m 8192 -hda ubuntu.img -accel kvm -smp 12
#test-case-05-io-seqrewr
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr cleanup
```

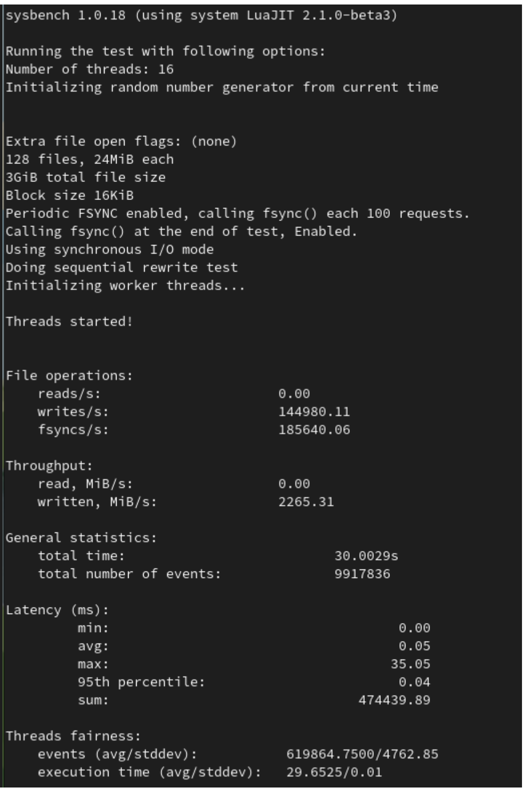


```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     145880.05
    fsyncs/s:                     186790.89

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               2279.38

General statistics:
    total time:                          30.0017s
    total number of events:              9978966

Latency (ms):
         min:                                    0.00
         avg:                                    0.05
         max:                                   36.78
         95th percentile:                        0.04
         sum:                               474482.24

Threads fairness:
    events (avg/stddev):           623685.3750/4627.64
    execution time (avg/stddev):   29.6551/0.01
```

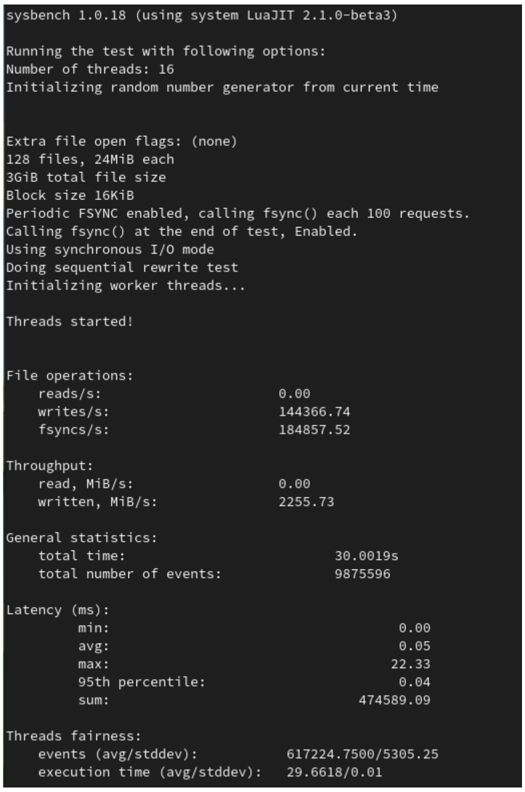
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     146650.91
    fsyncs/s:                     187777.41

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               2291.42

General statistics:
    total time:                          30.0023s
    total number of events:              10031866

Latency (ms):
         min:                                    0.00
         avg:                                    0.05
         max:                                   29.40
         95th percentile:                        0.04
         sum:                               474479.60

Threads fairness:
    events (avg/stddev):           626991.6250/5554.14
    execution time (avg/stddev):   29.6550/0.01
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     145643.39
    fsyncs/s:                     186490.56

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               2275.68

General statistics:
    total time:                          30.0020s
    total number of events:              9962945

Latency (ms):
         min:                                    0.00
         avg:                                    0.05
         max:                                   22.11
         95th percentile:                        0.04
         sum:                               474613.75

Threads fairness:
    events (avg/stddev):           622684.0625/4703.36
    execution time (avg/stddev):   29.6634/0.01
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     144980.11
    fsyncs/s:                     185640.06

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               2265.31

General statistics:
    total time:                          30.0029s
    total number of events:              9917836

Latency (ms):
         min:                                    0.00
         avg:                                    0.05
         max:                                   35.05
         95th percentile:                        0.04
         sum:                               474439.89

Threads fairness:
    events (avg/stddev):           619864.7500/4762.85
    execution time (avg/stddev):   29.6525/0.01
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     144366.74
    fsyncs/s:                     184857.52

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               2255.73

General statistics:
    total time:                          30.0019s
    total number of events:              9875596

Latency (ms):
         min:                                    0.00
         avg:                                    0.05
         max:                                   22.33
         95th percentile:                        0.04
         sum:                               474589.09

Threads fairness:
    events (avg/stddev):           617224.7500/5305.25
    execution time (avg/stddev):   29.6618/0.01
```

The following table shows the performance evaluations for test case scenario.

Iteration	writes/s	fsyncs/s	Throughput (written)
1	5376.45	6945.66	84.01
2	5478.02	7079.74	85.59

Iteration	writes/s	fsyncs/s	Throughput (written)
3	5337.46	6899.28	83.40
4	4820.56	6235.70	75.32
5	5197.70	6717.29	81.21
average values	5223.56	6776.57	81.19

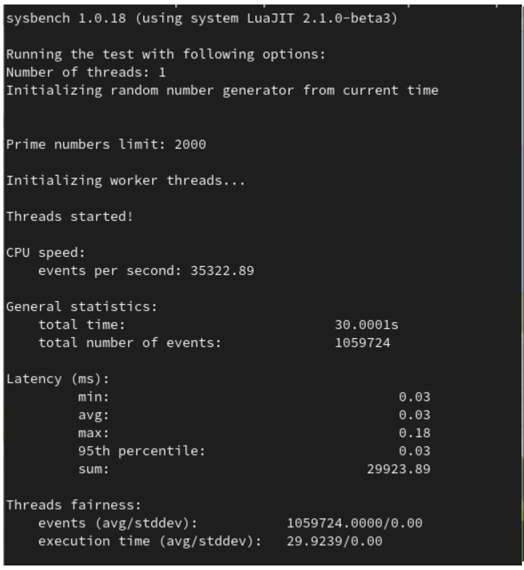
Screenshots Docker:

The following report depicts screenshots with tables to showcase average values for each scenario and testcase in Docker Virtualization.

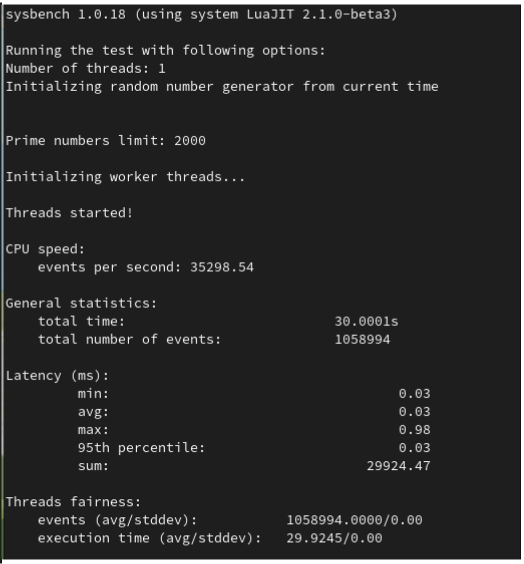
Scenario - 1 & Testcase - 1

These screenshots depict five iterations of testcase 1 in scenario 1 in Docker.

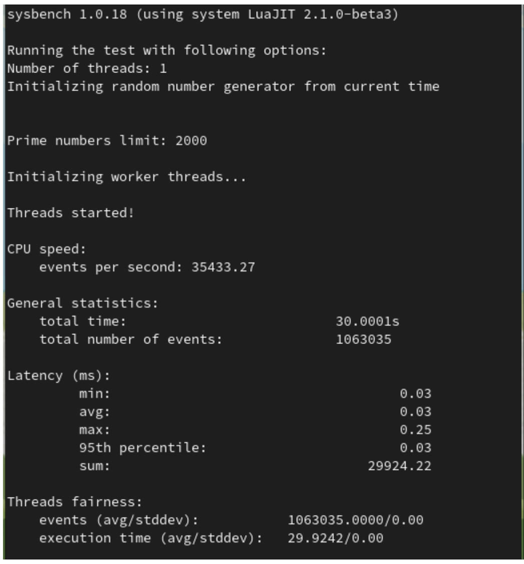
```
#scenario-1 : 2 GiB of RAM, 2 CPUs allocated
$ sudo docker run -it --cpus="2" --memory="2g" my_image_with_sysbench:latest
#test-case-01-cpu-2000
sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
```



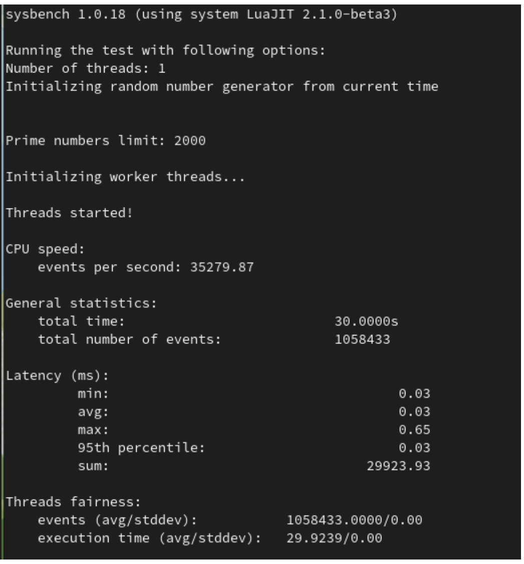
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 35322.89

General statistics:
    total time:                          30.0001s
    total number of events:              1059724

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.18
         95th percentile:                        0.03
         sum:                                29923.89

Threads fairness:
    events (avg/stddev):           1059724.0000/0.00
    execution time (avg/stddev):   29.9239/0.00
```



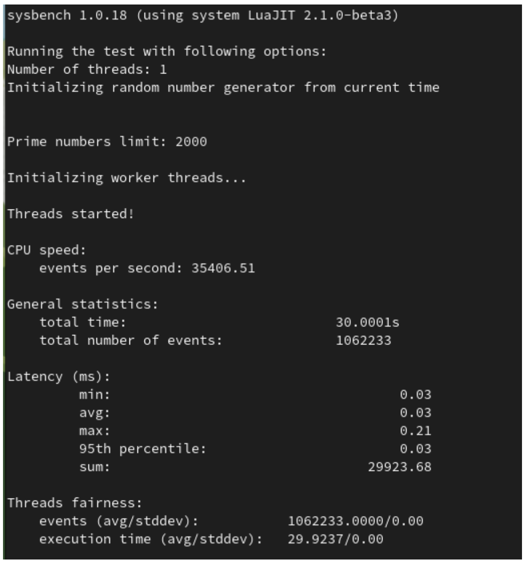
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 35298.54

General statistics:
    total time:                          30.0001s
    total number of events:              1058994

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.98
         95th percentile:                        0.03
         sum:                                29924.47

Threads fairness:
    events (avg/stddev):           1058994.0000/0.00
    execution time (avg/stddev):   29.9245/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 35433.27

General statistics:
    total time:                          30.0001s
    total number of events:              1063035

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.25
         95th percentile:                        0.03
         sum:                                29924.22

Threads fairness:
    events (avg/stddev):           1063035.0000/0.00
    execution time (avg/stddev):   29.9242/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 35279.87

General statistics:
    total time:                          30.0000s
    total number of events:              1058433

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.65
         95th percentile:                        0.03
         sum:                                29923.93

Threads fairness:
    events (avg/stddev):           1058433.0000/0.00
    execution time (avg/stddev):   29.9239/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 35406.51

General statistics:
    total time:                          30.0001s
    total number of events:              1062233

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.21
         95th percentile:                        0.03
         sum:                                29923.68

Threads fairness:
    events (avg/stddev):           1062233.0000/0.00
    execution time (avg/stddev):   29.9237/0.00
```

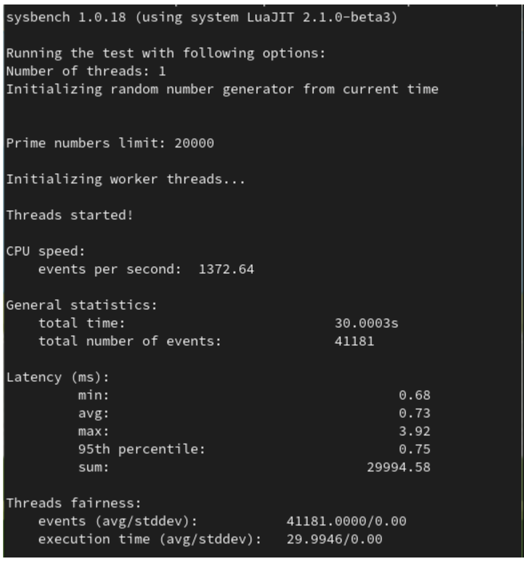
The following table shows the Events per second for test case scenario.

Iteration	**Events per second**
1	35322.89
2	35298.54
3	35433.27 (**MAX**)
4	35279.87 (**MIN**)
5	35406.51
Average Events per second	35328.82

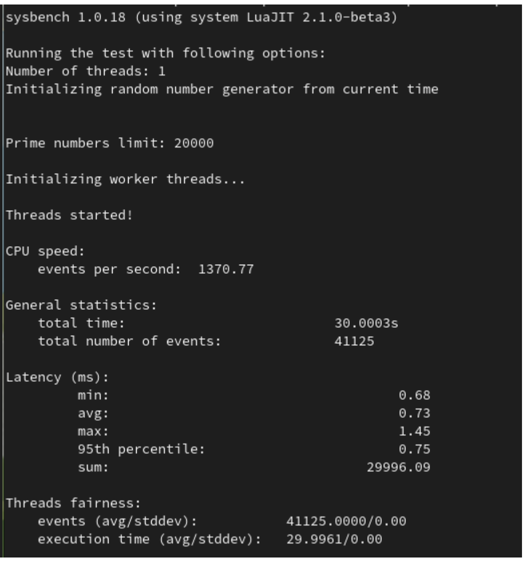
Scenario - 1 & Testcase - 2

These screenshots depict five iterations of testcase 2 in scenario 1 in Docker.

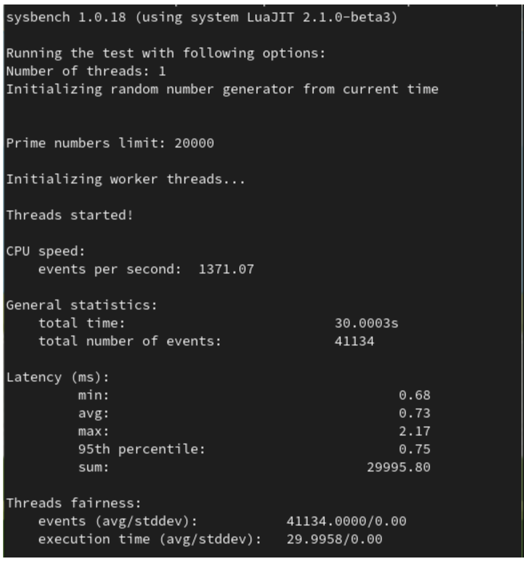
```
#scenario-1 : 2 GiB of RAM, 2 CPUs allocated
$ sudo docker run -it --cpus="2" --memory="2g" my_image_with_sysbench:latest
#test-case-02-cpu-20000
sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
```



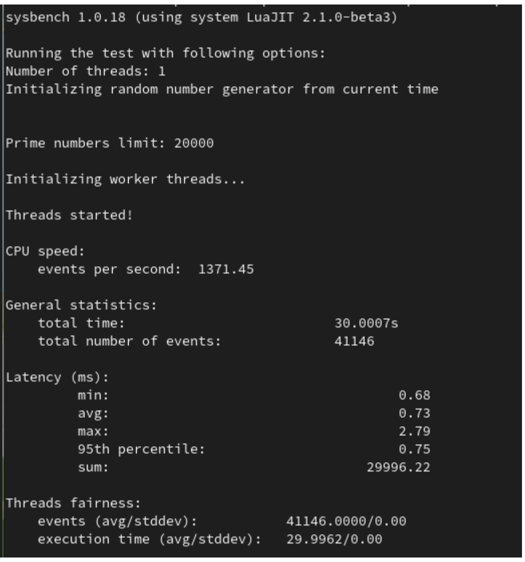
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1372.64

General statistics:
    total time:                          30.0003s
    total number of events:              41181

Latency (ms):
         min:                                    0.68
         avg:                                    0.73
         max:                                    3.92
         95th percentile:                        0.75
         sum:                                29994.58

Threads fairness:
    events (avg/stddev):           41181.0000/0.00
    execution time (avg/stddev):   29.9946/0.00
```



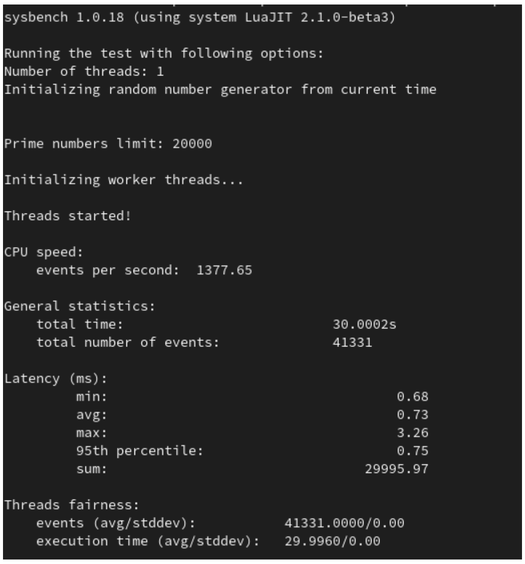
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1370.77

General statistics:
    total time:                          30.0003s
    total number of events:              41125

Latency (ms):
         min:                                    0.68
         avg:                                    0.73
         max:                                    1.45
         95th percentile:                        0.75
         sum:                                29996.09

Threads fairness:
    events (avg/stddev):           41125.0000/0.00
    execution time (avg/stddev):   29.9961/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1371.07

General statistics:
    total time:                          30.0003s
    total number of events:              41134

Latency (ms):
         min:                                    0.68
         avg:                                    0.73
         max:                                    2.17
         95th percentile:                        0.75
         sum:                                29995.80

Threads fairness:
    events (avg/stddev):           41134.0000/0.00
    execution time (avg/stddev):   29.9958/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1371.45

General statistics:
    total time:                          30.0007s
    total number of events:              41146

Latency (ms):
         min:                                    0.68
         avg:                                    0.73
         max:                                    2.79
         95th percentile:                        0.75
         sum:                                29996.22

Threads fairness:
    events (avg/stddev):           41146.0000/0.00
    execution time (avg/stddev):   29.9962/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1377.65

General statistics:
    total time:                          30.0002s
    total number of events:              41331

Latency (ms):
         min:                                    0.68
         avg:                                    0.73
         max:                                    3.26
         95th percentile:                        0.75
         sum:                                29995.97

Threads fairness:
    events (avg/stddev):           41331.0000/0.00
    execution time (avg/stddev):   29.9960/0.00
```

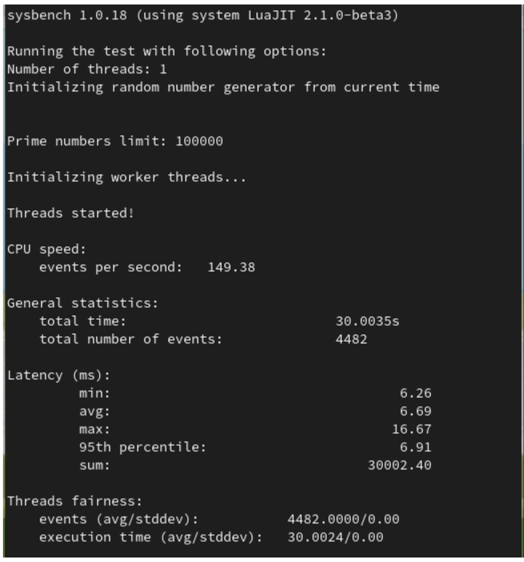
The following table shows the Events per second for test case scenario.

Iteration	**Events per second**
1	1372.64
2	1370.77 (**MIN**)
3	1371.07
4	1371.45
5	1377.65 (**MAX**)
Average Events per second	1372.7

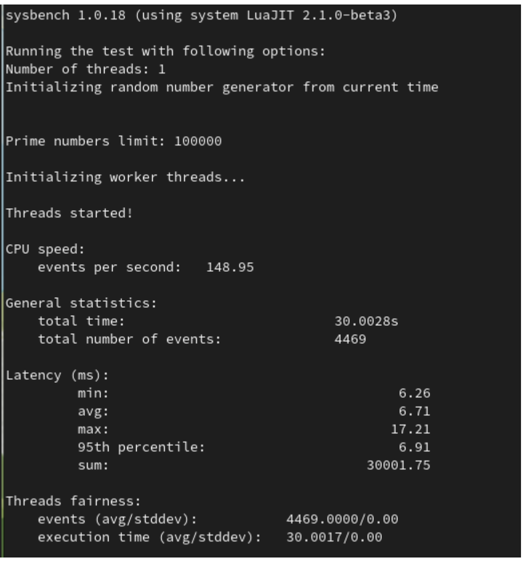
Scenario - 1 & Testcase - 3

These screenshots depict five iterations of testcase 3 in scenario 1 in Docker.

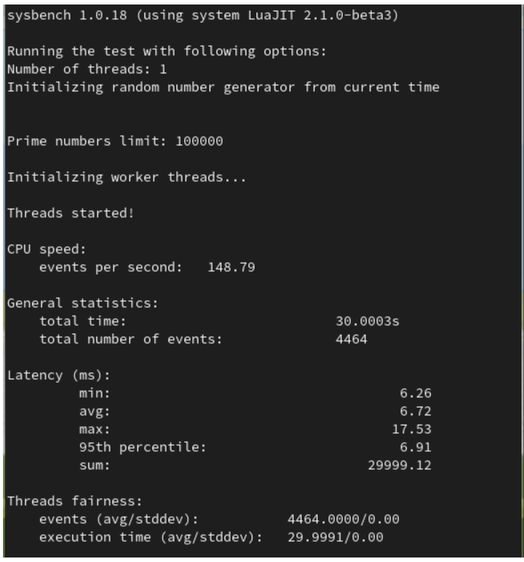
```
#scenario-1 : 2 GiB of RAM, 2 CPUs allocated
$ sudo docker run -it --cpus="2" --memory="2g" my_image_with_sysbench:latest
#test-case-03-cpu-100000
sysbench --test=cpu --cpu-max-prime=100000 --time=30 run
```



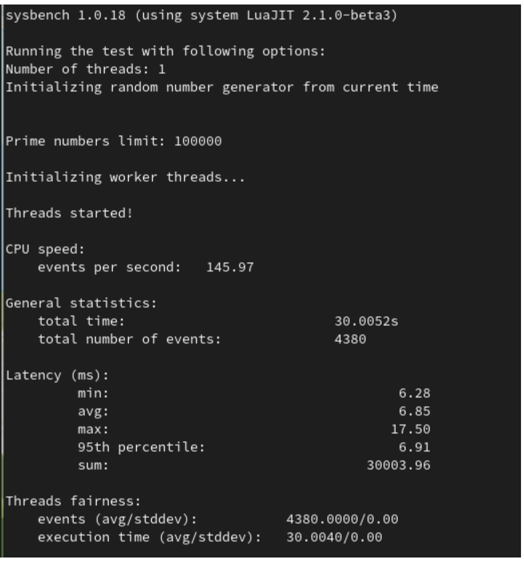
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   149.38

General statistics:
    total time:                          30.0035s
    total number of events:              4482

Latency (ms):
         min:                                    6.26
         avg:                                    6.69
         max:                                   16.67
         95th percentile:                        6.91
         sum:                                30002.40

Threads fairness:
    events (avg/stddev):           4482.0000/0.00
    execution time (avg/stddev):   30.0024/0.00
```



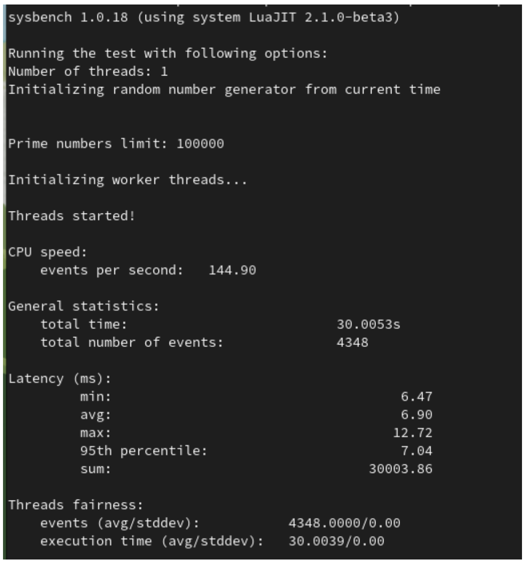
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   148.95

General statistics:
    total time:                          30.0028s
    total number of events:              4469

Latency (ms):
         min:                                    6.26
         avg:                                    6.71
         max:                                   17.21
         95th percentile:                        6.91
         sum:                                30001.75

Threads fairness:
    events (avg/stddev):           4469.0000/0.00
    execution time (avg/stddev):   30.0017/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   148.79

General statistics:
    total time:                          30.0003s
    total number of events:              4464

Latency (ms):
         min:                                    6.26
         avg:                                    6.72
         max:                                   17.53
         95th percentile:                        6.91
         sum:                                29999.12

Threads fairness:
    events (avg/stddev):           4464.0000/0.00
    execution time (avg/stddev):   29.9991/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.97

General statistics:
    total time:                          30.0052s
    total number of events:              4380

Latency (ms):
         min:                                    6.28
         avg:                                    6.85
         max:                                   17.50
         95th percentile:                        6.91
         sum:                                30003.96

Threads fairness:
    events (avg/stddev):           4380.0000/0.00
    execution time (avg/stddev):   30.0040/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   144.90

General statistics:
    total time:                          30.0053s
    total number of events:              4348

Latency (ms):
         min:                                    6.47
         avg:                                    6.90
         max:                                   12.72
         95th percentile:                        7.04
         sum:                                30003.86

Threads fairness:
    events (avg/stddev):           4348.0000/0.00
    execution time (avg/stddev):   30.0039/0.00
```

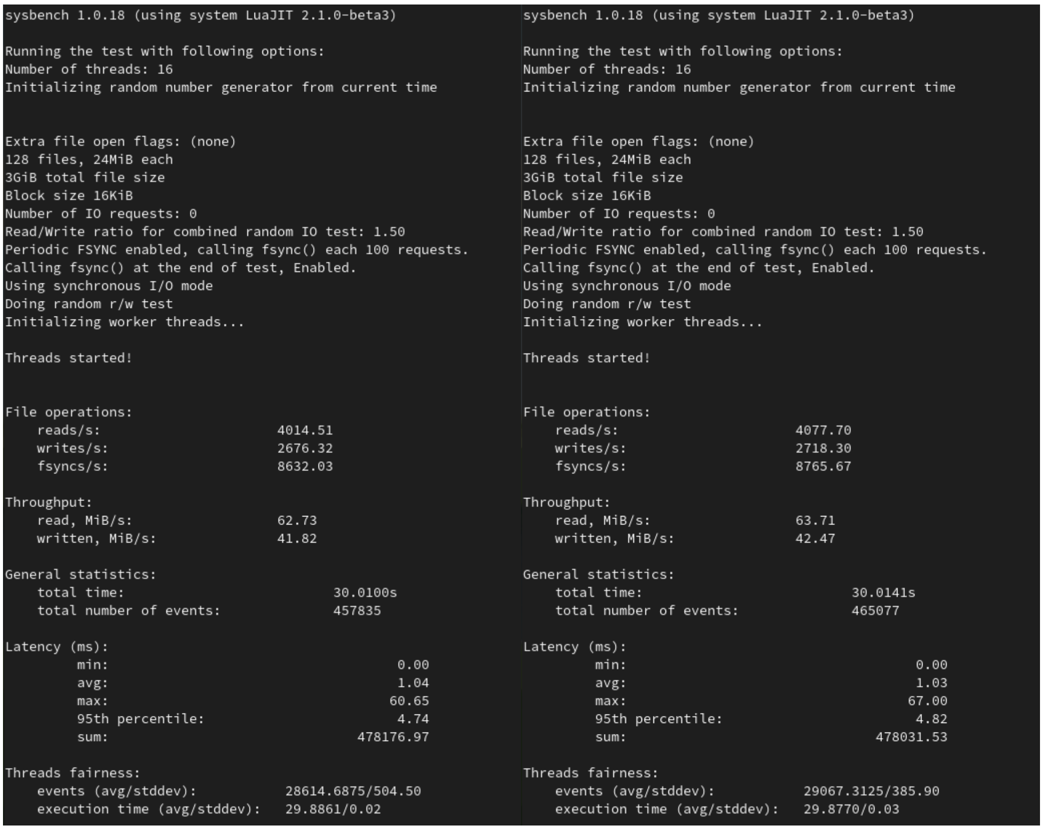
The following table shows the Events per second for test case scenario.

Iteration	**Events per second**
1	149.38 (**MAX**)
2	148.95
3	148.79
4	145.97
5	144.90 (**MIN**)
Average Events per second	147.25

Scenario - 1 & Testcase - 4

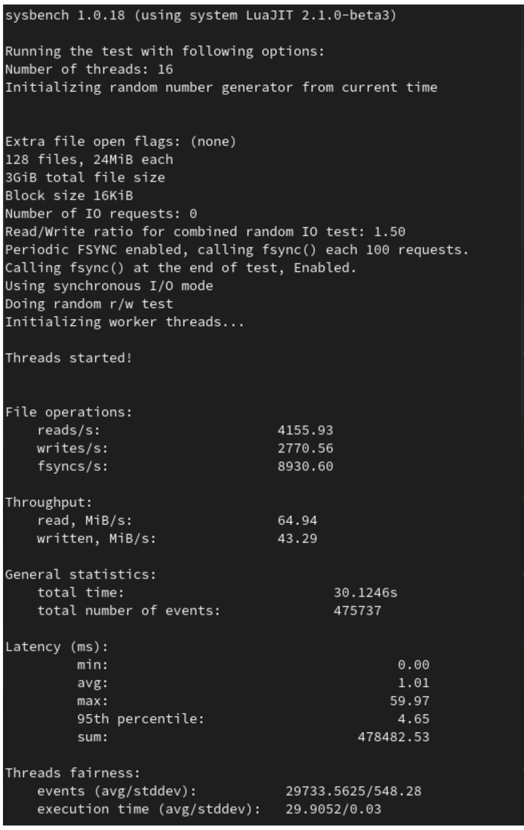
These screenshots depict five iterations of testcase 4 in scenario 1 in Docker.

```
#scenario-1 : 2 GiB of RAM, 2 CPUs allocated
$ sudo docker run -it --cpus="2" --memory="2g" my_image_with_sysbench:latest
#test-case-04-io-rndrw
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw cleanup
```

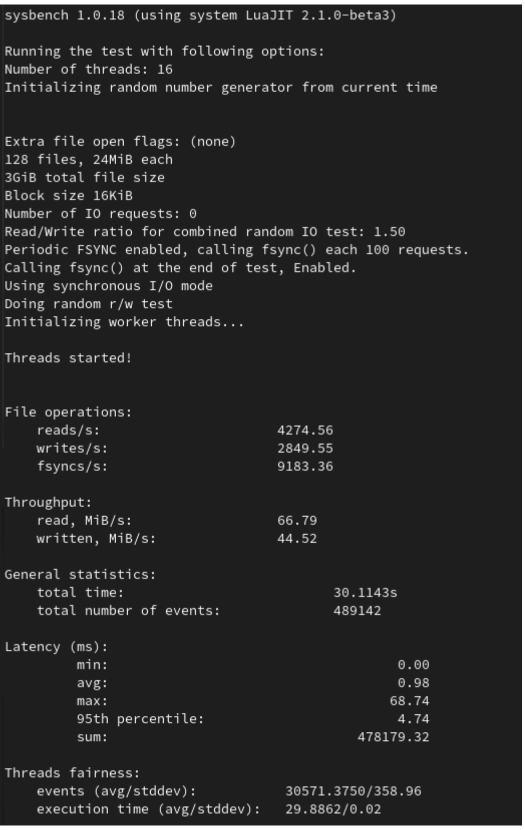


```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      4014.51
    writes/s:                     2676.32
    fsyncs/s:                     8632.03

Throughput:
    read, MiB/s:                  62.73
    written, MiB/s:               41.82

General statistics:
    total time:                          30.0100s
    total number of events:              457835

Latency (ms):
         min:                                    0.00
         avg:                                    1.04
         max:                                   60.65
         95th percentile:                        4.74
         sum:                               478176.97

Threads fairness:
    events (avg/stddev):           28614.6875/504.50
    execution time (avg/stddev):   29.8861/0.02
```

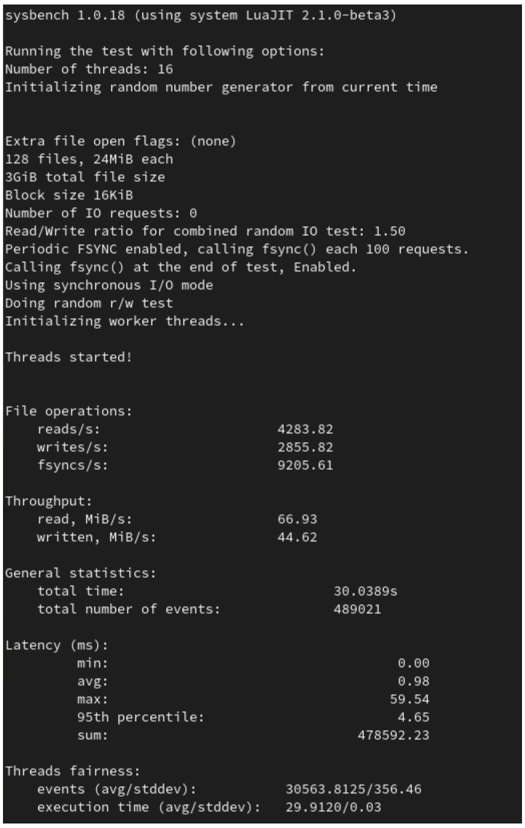
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      4077.70
    writes/s:                     2718.30
    fsyncs/s:                     8765.67

Throughput:
    read, MiB/s:                  63.71
    written, MiB/s:               42.47

General statistics:
    total time:                          30.0141s
    total number of events:              465077

Latency (ms):
         min:                                    0.00
         avg:                                    1.03
         max:                                   67.00
         95th percentile:                        4.82
         sum:                               478031.53

Threads fairness:
    events (avg/stddev):           29067.3125/385.90
    execution time (avg/stddev):   29.8770/0.03
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      4155.93
    writes/s:                     2770.56
    fsyncs/s:                     8930.60

Throughput:
    read, MiB/s:                  64.94
    written, MiB/s:               43.29

General statistics:
    total time:                          30.1246s
    total number of events:              475737

Latency (ms):
         min:                                    0.00
         avg:                                    1.01
         max:                                   59.97
         95th percentile:                        4.65
         sum:                               478482.53

Threads fairness:
    events (avg/stddev):           29733.5625/548.28
    execution time (avg/stddev):   29.9052/0.03
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      4274.56
    writes/s:                     2849.55
    fsyncs/s:                     9183.36

Throughput:
    read, MiB/s:                  66.79
    written, MiB/s:               44.52

General statistics:
    total time:                          30.1143s
    total number of events:              489142

Latency (ms):
         min:                                    0.00
         avg:                                    0.98
         max:                                   68.74
         95th percentile:                        4.74
         sum:                               478179.32

Threads fairness:
    events (avg/stddev):           30571.3750/358.96
    execution time (avg/stddev):   29.8862/0.02
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      4283.82
    writes/s:                     2855.82
    fsyncs/s:                     9205.61

Throughput:
    read, MiB/s:                  66.93
    written, MiB/s:               44.62

General statistics:
    total time:                          30.0389s
    total number of events:              489021

Latency (ms):
         min:                                    0.00
         avg:                                    0.98
         max:                                   59.54
         95th percentile:                        4.65
         sum:                               478592.23

Threads fairness:
    events (avg/stddev):           30563.8125/356.46
    execution time (avg/stddev):   29.9120/0.03
```

The following table shows the performance evaluations for test case scenario.

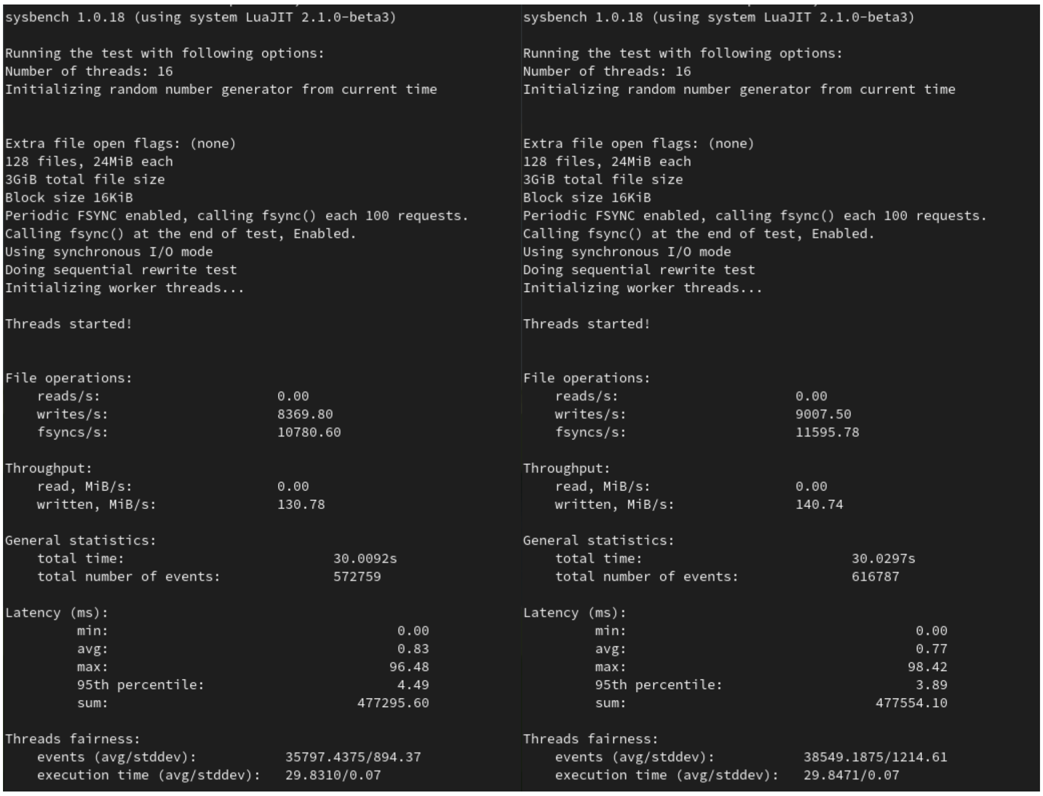
Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
1	4014.51	2676.32	8632.03	62.73	41.82

Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
2	4077.70	2718.30	8765.67	63.71	42.47
3	4155.93	2770.56	8930.60	64.94	43.29
4	4274.56	2849.55	9183.36	66.79	44.52
5	4283.82	2855.82	9205.61	66.93	44.62
average values	4159.50	2733.91	8603.25	64.82	43.34

Scenario - 1 & Testcase - 5

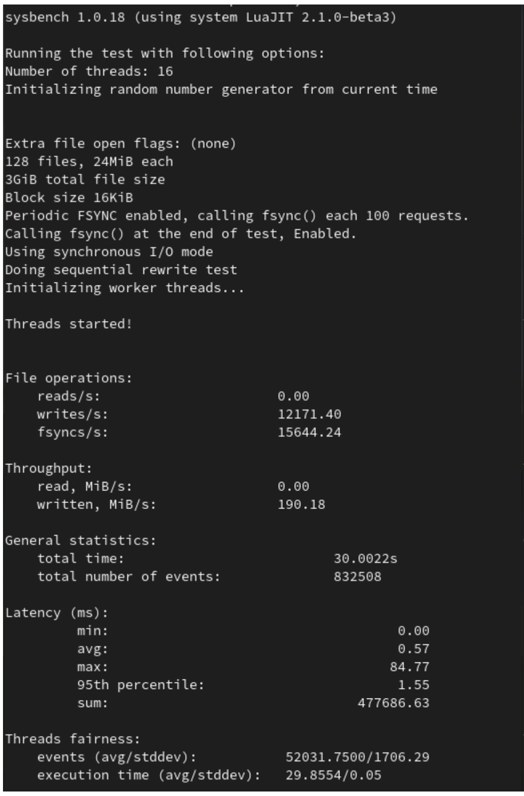
These screenshots depict five iterations of testcase 5 in scenario 1 in Docker.

```
#scenario-1 : 2 GiB of RAM, 2 CPUs allocated
$ sudo docker run -it --cpus="2" --memory="2g" my_image_with_sysbench:latest
#test-case-05-io-seqrewr
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr cleanup
```

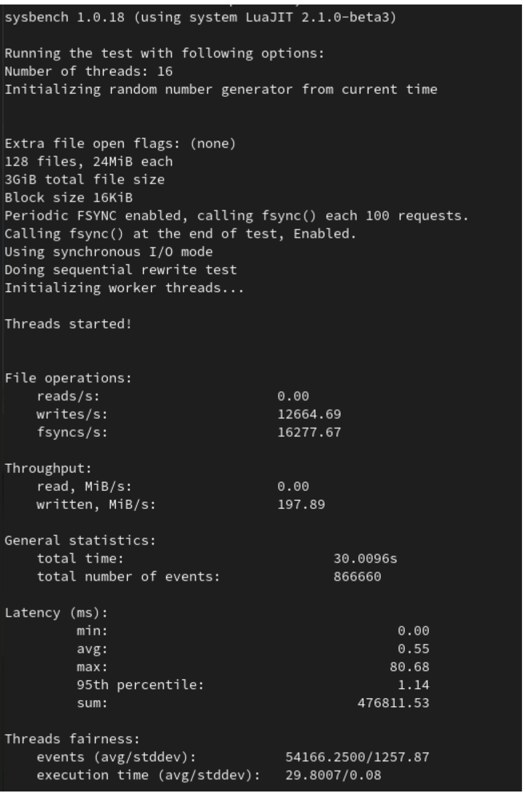


```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     8369.80
    fsyncs/s:                     10780.60

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               130.78

General statistics:
    total time:                          30.0092s
    total number of events:              572759

Latency (ms):
         min:                                    0.00
         avg:                                    0.83
         max:                                   96.48
         95th percentile:                        4.49
         sum:                               477295.60

Threads fairness:
    events (avg/stddev):           35797.4375/894.37
    execution time (avg/stddev):   29.8310/0.07
```

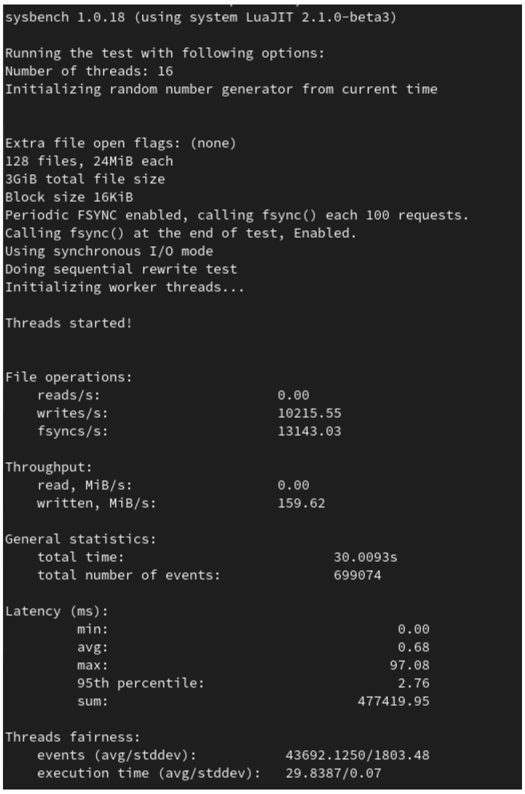
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     9007.50
    fsyncs/s:                     11595.78

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               140.74

General statistics:
    total time:                          30.0297s
    total number of events:              616787

Latency (ms):
         min:                                    0.00
         avg:                                    0.77
         max:                                   98.42
         95th percentile:                        3.89
         sum:                               477554.10

Threads fairness:
    events (avg/stddev):           38549.1875/1214.61
    execution time (avg/stddev):   29.8471/0.07
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     12171.40
    fsyncs/s:                     15644.24

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               190.18

General statistics:
    total time:                          30.0022s
    total number of events:              832508

Latency (ms):
         min:                                    0.00
         avg:                                    0.57
         max:                                   84.77
         95th percentile:                        1.55
         sum:                               477686.63

Threads fairness:
    events (avg/stddev):           52031.7500/1706.29
    execution time (avg/stddev):   29.8554/0.05
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     12664.69
    fsyncs/s:                     16277.67

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               197.89

General statistics:
    total time:                          30.0096s
    total number of events:              866660

Latency (ms):
         min:                                    0.00
         avg:                                    0.55
         max:                                   80.68
         95th percentile:                        1.14
         sum:                               476811.53

Threads fairness:
    events (avg/stddev):           54166.2500/1257.87
    execution time (avg/stddev):   29.8007/0.08
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     10215.55
    fsyncs/s:                     13143.03

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               159.62

General statistics:
    total time:                          30.0093s
    total number of events:              699074

Latency (ms):
         min:                                    0.00
         avg:                                    0.68
         max:                                   97.08
         95th percentile:                        2.76
         sum:                               477419.95

Threads fairness:
    events (avg/stddev):           43692.1250/1803.48
    execution time (avg/stddev):   29.8387/0.07
```

The following table shows the performance evaluations for test case scenario.

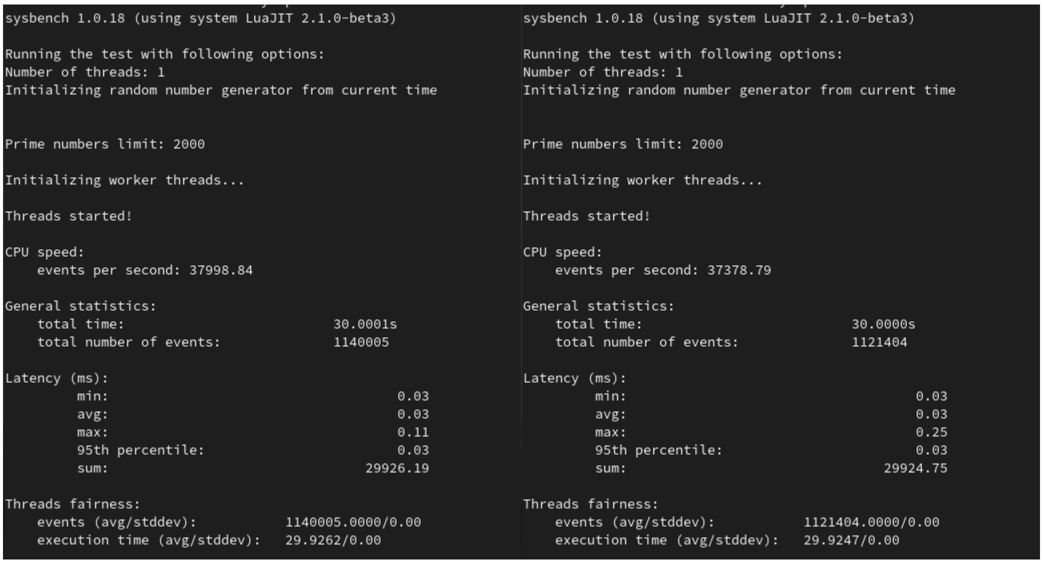
Iteration	writes/s	fsyncs/s	Throughput (written)
1	8369.80	10780.60	130.78
2	9007.50	11595.78	140.74

Iteration	writes/s	fsyncs/s	Throughput (written)
3	12171.40	15644.24	190.18
4	12664.69	16277.67	197.89
5	10215.55	13143.03	159.62
average values	10183.68	13449.26	163.66

Scenario - 2 & Testcase - 1

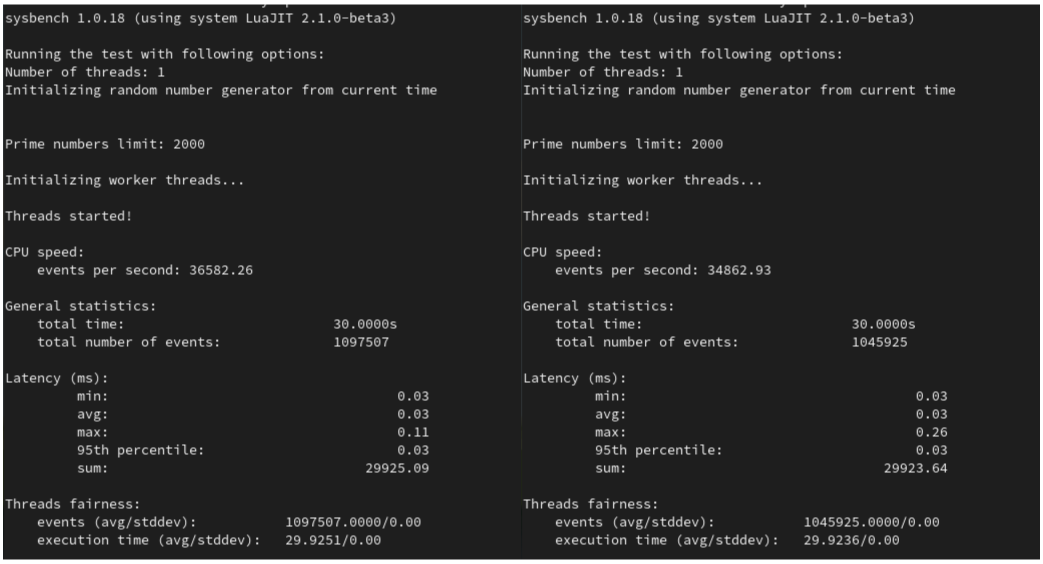
These screenshots depict five iterations of testcase 1 in scenario 2 in Docker.

```
#scenario-2 : 4 GiB of RAM, 4 CPUs allocated
$ sudo docker run -it --cpus="4" --memory="4g" my_image_with_sysbench:latest
#test-case-01-cpu-2000
sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
```



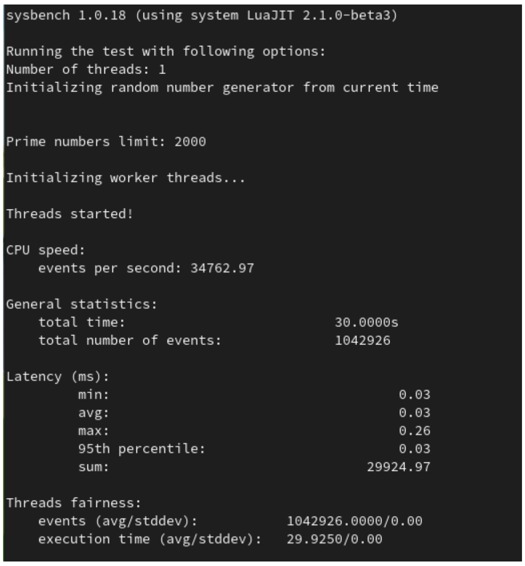
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37998.84

General statistics:
    total time:                          30.0001s
    total number of events:              1140005

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.11
         95th percentile:                        0.03
         sum:                                29926.19

Threads fairness:
    events (avg/stddev):           1140005.0000/0.00
    execution time (avg/stddev):   29.9262/0.00
```

```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37378.79

General statistics:
    total time:                          30.0000s
    total number of events:              1121404

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.25
         95th percentile:                        0.03
         sum:                                29924.75

Threads fairness:
    events (avg/stddev):           1121404.0000/0.00
    execution time (avg/stddev):   29.9247/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 36582.26

General statistics:
    total time:                          30.0000s
    total number of events:              1097507

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.11
         95th percentile:                        0.03
         sum:                                29925.09

Threads fairness:
    events (avg/stddev):           1097507.0000/0.00
    execution time (avg/stddev):   29.9251/0.00
```

```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34862.93

General statistics:
    total time:                          30.0000s
    total number of events:              1045925

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.26
         95th percentile:                        0.03
         sum:                                29923.64

Threads fairness:
    events (avg/stddev):           1045925.0000/0.00
    execution time (avg/stddev):   29.9236/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34762.97

General statistics:
    total time:                          30.0000s
    total number of events:              1042926

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.26
         95th percentile:                        0.03
         sum:                                29924.97

Threads fairness:
    events (avg/stddev):           1042926.0000/0.00
    execution time (avg/stddev):   29.9250/0.00
```

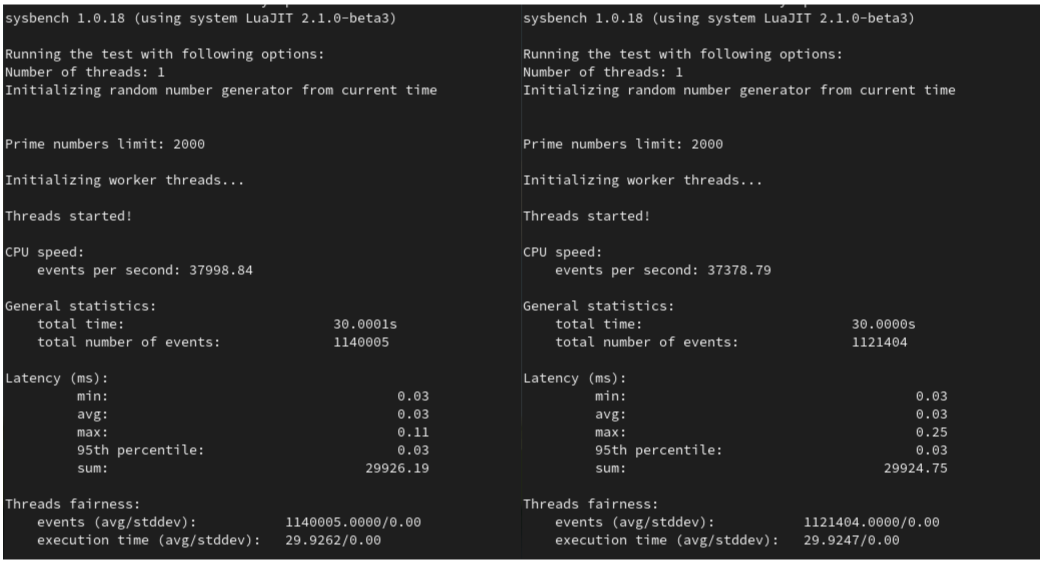
The following table shows the Events per second for test case scenario.

Iteration	Events per second
1	37998.84 (**MAX**)
2	37378.79
3	36582.26
4	34862.93
5	34762.97 (**MIN**)
Average Events per second	36697.35

Scenario - 2 & Testcase - 2

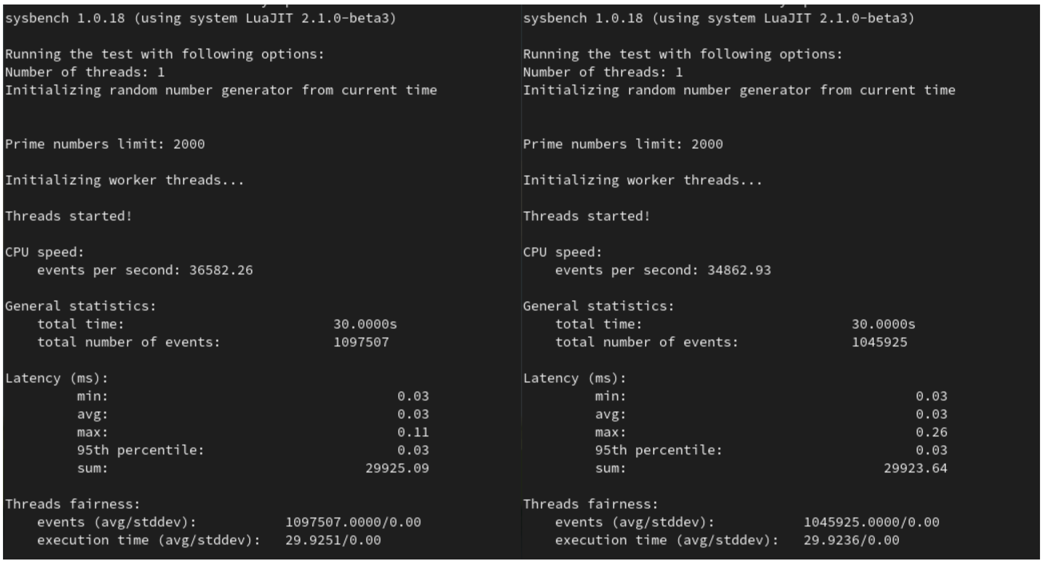
These screenshots depict five iterations of testcase 2 in scenario 2 in Docker.

```
#scenario-2 : 4 GiB of RAM, 4 CPUs allocated
$ sudo docker run -it --cpus="4" --memory="4g" my_image_with_sysbench:latest
#test-case-02-cpu-20000
sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
```



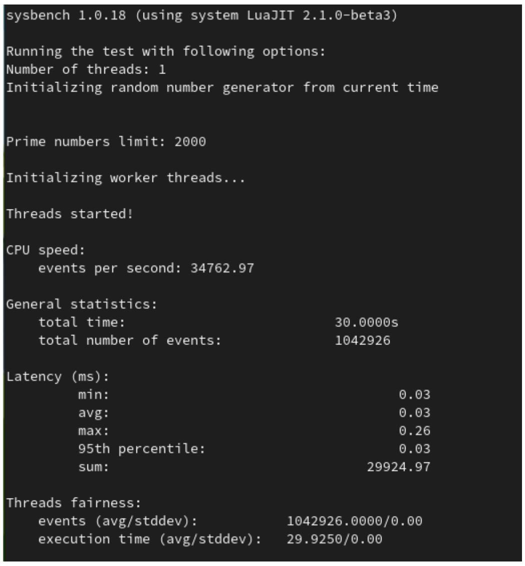
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37998.84

General statistics:
    total time:                          30.0001s
    total number of events:              1140005

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.11
         95th percentile:                        0.03
         sum:                                29926.19

Threads fairness:
    events (avg/stddev):           1140005.0000/0.00
    execution time (avg/stddev):   29.9262/0.00
```

```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37378.79

General statistics:
    total time:                          30.0000s
    total number of events:              1121404

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.25
         95th percentile:                        0.03
         sum:                                29924.75

Threads fairness:
    events (avg/stddev):           1121404.0000/0.00
    execution time (avg/stddev):   29.9247/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 36582.26

General statistics:
    total time:                          30.0000s
    total number of events:              1097507

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.11
         95th percentile:                        0.03
         sum:                                29925.09

Threads fairness:
    events (avg/stddev):           1097507.0000/0.00
    execution time (avg/stddev):   29.9251/0.00
```

```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34862.93

General statistics:
    total time:                          30.0000s
    total number of events:              1045925

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.26
         95th percentile:                        0.03
         sum:                                29923.64

Threads fairness:
    events (avg/stddev):           1045925.0000/0.00
    execution time (avg/stddev):   29.9236/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 34762.97

General statistics:
    total time:                          30.0000s
    total number of events:              1042926

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.26
         95th percentile:                        0.03
         sum:                                29924.97

Threads fairness:
    events (avg/stddev):           1042926.0000/0.00
    execution time (avg/stddev):   29.9250/0.00
```

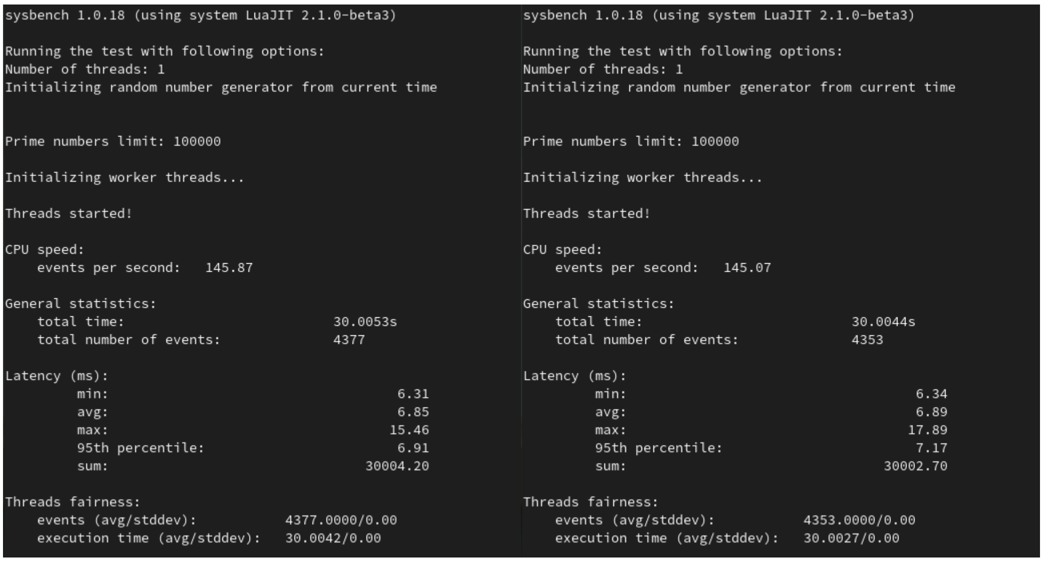
The following table shows the Events per second for test case scenario.

Iteration	Events per second
1	1341.13
2	1341.25
3	1343.26 (**MAX**)
4	1339.58
5	1337.59 (**MIN**)
Average Events per second	1340.56

Scenario - 2 & Testcase - 3

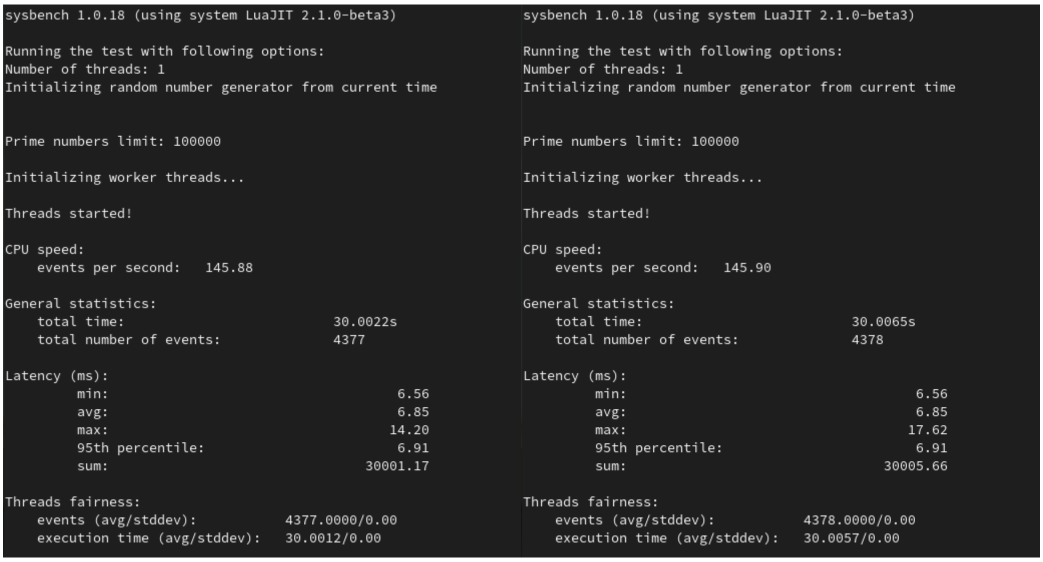
These screenshots depict five iterations of testcase 3 in scenario 2 in Docker.

```
#scenario-2 : 4 GiB of RAM, 4 CPUs allocated
$ sudo docker run -it --cpus="4" --memory="4g" my_image_with_sysbench:latest
#test-case-03-cpu-100000
sysbench --test=cpu --cpu-max-prime=100000 --time=30 run
```



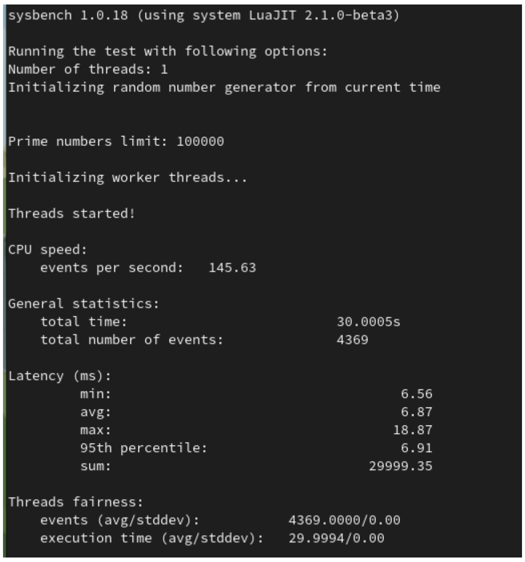
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.87

General statistics:
    total time:                          30.0053s
    total number of events:              4377

Latency (ms):
         min:                                    6.31
         avg:                                    6.85
         max:                                   15.46
         95th percentile:                        6.91
         sum:                                30004.20

Threads fairness:
    events (avg/stddev):           4377.0000/0.00
    execution time (avg/stddev):   30.0042/0.00
```

```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.07

General statistics:
    total time:                          30.0044s
    total number of events:              4353

Latency (ms):
         min:                                    6.34
         avg:                                    6.89
         max:                                   17.89
         95th percentile:                        7.17
         sum:                                30002.70

Threads fairness:
    events (avg/stddev):           4353.0000/0.00
    execution time (avg/stddev):   30.0027/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.88

General statistics:
    total time:                          30.0022s
    total number of events:              4377

Latency (ms):
         min:                                    6.56
         avg:                                    6.85
         max:                                   14.20
         95th percentile:                        6.91
         sum:                                30001.17

Threads fairness:
    events (avg/stddev):           4377.0000/0.00
    execution time (avg/stddev):   30.0012/0.00
```

```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.90

General statistics:
    total time:                          30.0065s
    total number of events:              4378

Latency (ms):
         min:                                    6.56
         avg:                                    6.85
         max:                                   17.62
         95th percentile:                        6.91
         sum:                                30005.66

Threads fairness:
    events (avg/stddev):           4378.0000/0.00
    execution time (avg/stddev):   30.0057/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.63

General statistics:
    total time:                          30.0005s
    total number of events:              4369

Latency (ms):
         min:                                    6.56
         avg:                                    6.87
         max:                                   18.87
         95th percentile:                        6.91
         sum:                                29999.35

Threads fairness:
    events (avg/stddev):           4369.0000/0.00
    execution time (avg/stddev):   29.9994/0.00
```

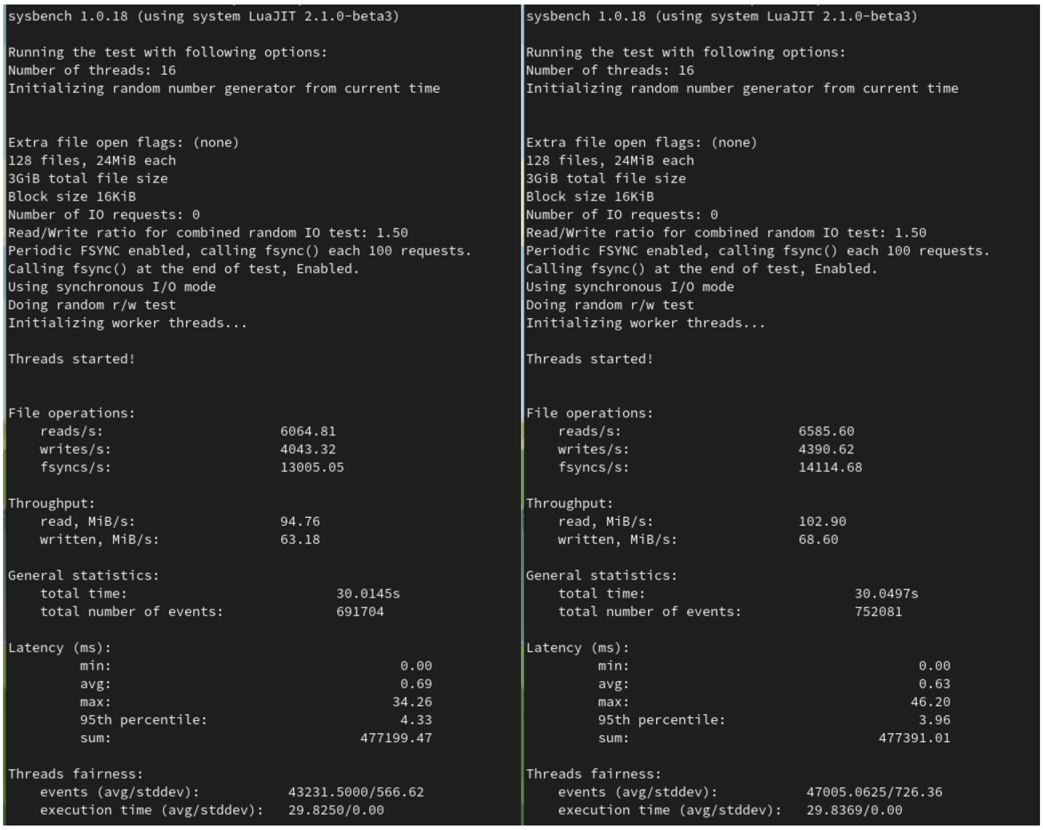
The following table shows the Events per second for test case scenario.

Iteration	**Events per second**
1	145.87
2	145.07 (**MIN**)
3	145.88
4	145.90 (**MAX**)
5	145.63
Average Events per second	145.67

Scenario - 2 & Testcase - 4

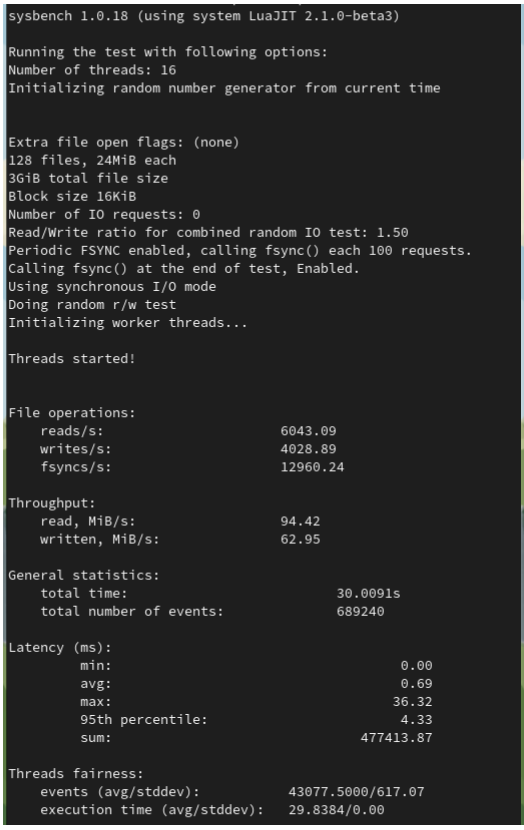
These screenshots depict five iterations of testcase 4 in scenario 2 in Docker.

```
#scenario-2 : 4 GiB of RAM, 4 CPUs allocated
$ sudo docker run -it --cpus="4" --memory="4g" my_image_with_sysbench:latest
#test-case-04-io-rndrw
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw cleanup
```

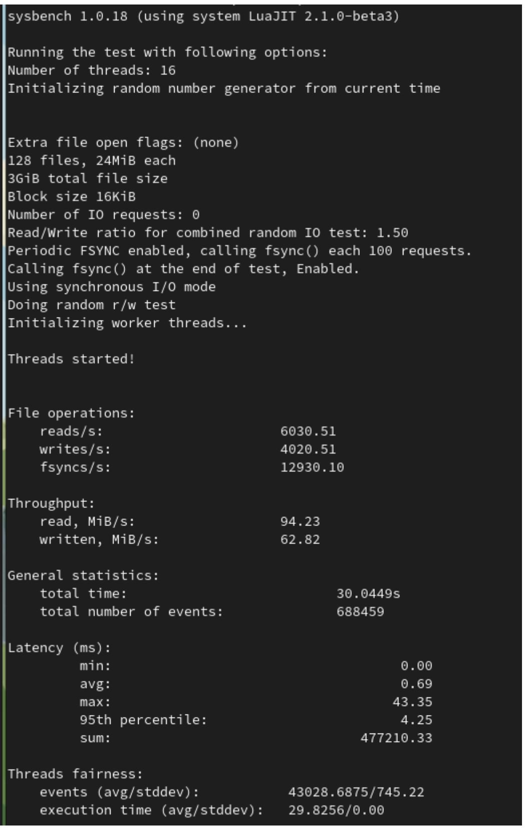


```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      6064.81
    writes/s:                     4043.32
    fsyncs/s:                     13005.05

Throughput:
    read, MiB/s:                  94.76
    written, MiB/s:               63.18

General statistics:
    total time:                          30.0145s
    total number of events:              691704

Latency (ms):
         min:                                    0.00
         avg:                                    0.69
         max:                                   34.26
         95th percentile:                        4.33
         sum:                               477199.47

Threads fairness:
    events (avg/stddev):           43231.5000/566.62
    execution time (avg/stddev):   29.8250/0.00
```

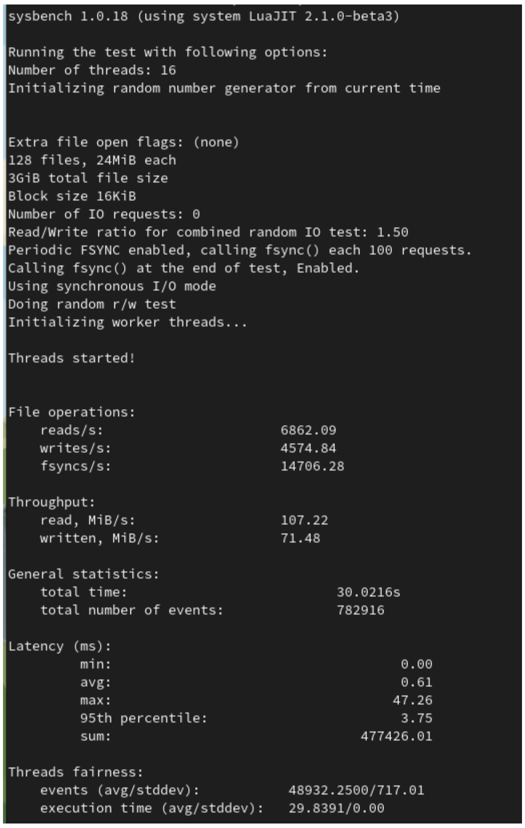
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      6585.60
    writes/s:                     4390.62
    fsyncs/s:                     14114.68

Throughput:
    read, MiB/s:                  102.90
    written, MiB/s:               68.60

General statistics:
    total time:                          30.0497s
    total number of events:              752081

Latency (ms):
         min:                                    0.00
         avg:                                    0.63
         max:                                   46.20
         95th percentile:                        3.96
         sum:                               477391.01

Threads fairness:
    events (avg/stddev):           47005.0625/726.36
    execution time (avg/stddev):   29.8369/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      6043.09
    writes/s:                     4028.89
    fsyncs/s:                     12960.24

Throughput:
    read, MiB/s:                  94.42
    written, MiB/s:               62.95

General statistics:
    total time:                          30.0091s
    total number of events:              689240

Latency (ms):
         min:                                    0.00
         avg:                                    0.69
         max:                                   36.32
         95th percentile:                        4.33
         sum:                               477413.87

Threads fairness:
    events (avg/stddev):           43077.5000/617.07
    execution time (avg/stddev):   29.8384/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      6030.51
    writes/s:                     4020.51
    fsyncs/s:                     12930.10

Throughput:
    read, MiB/s:                  94.23
    written, MiB/s:               62.82

General statistics:
    total time:                          30.0449s
    total number of events:              688459

Latency (ms):
         min:                                    0.00
         avg:                                    0.69
         max:                                   43.35
         95th percentile:                        4.25
         sum:                               477210.33

Threads fairness:
    events (avg/stddev):           43028.6875/745.22
    execution time (avg/stddev):   29.8256/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      6862.09
    writes/s:                     4574.84
    fsyncs/s:                     14706.28

Throughput:
    read, MiB/s:                  107.22
    written, MiB/s:               71.48

General statistics:
    total time:                          30.0216s
    total number of events:              782916

Latency (ms):
         min:                                    0.00
         avg:                                    0.61
         max:                                   47.26
         95th percentile:                        3.75
         sum:                               477426.01

Threads fairness:
    events (avg/stddev):           48932.2500/717.01
    execution time (avg/stddev):   29.8391/0.00
```

The following table shows the performance evaluations for test case scenario.

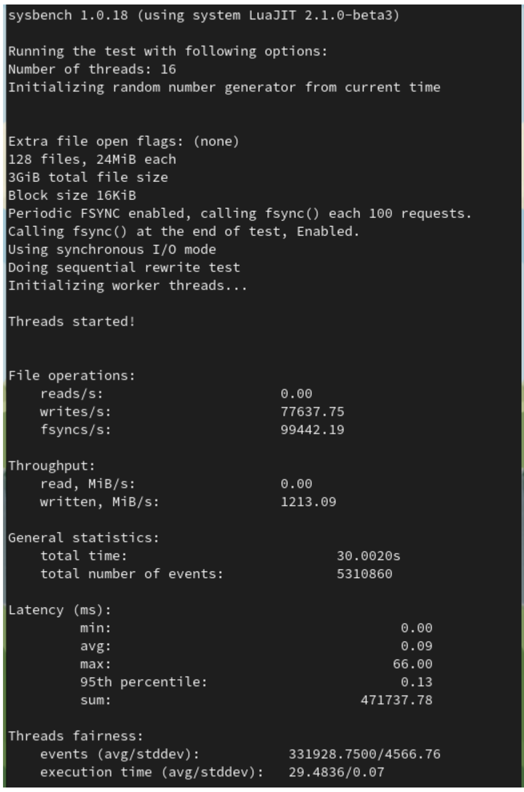
Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
1	6064.81	4043.32	13005.05	94.76	63.18

Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
2	6585.60	4390.62	14114.68	102.90	68.60
3	6043.09	4028.89	12960.24	94.42	62.95
4	6030.51	4020.51	12930.10	94.23	62.82
5	6862.09	4574.84	14706.28	107.22	71.48
average values	6317.22	4211.63	13543.27	98.70	65.80

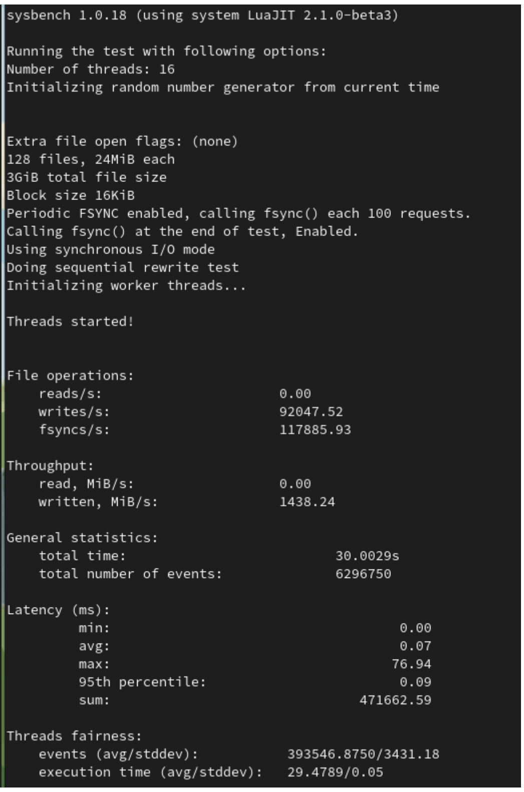
Scenario - 2 & Testcase - 5

These screenshots depict five iterations of testcase 5 in scenario 2 in Docker.

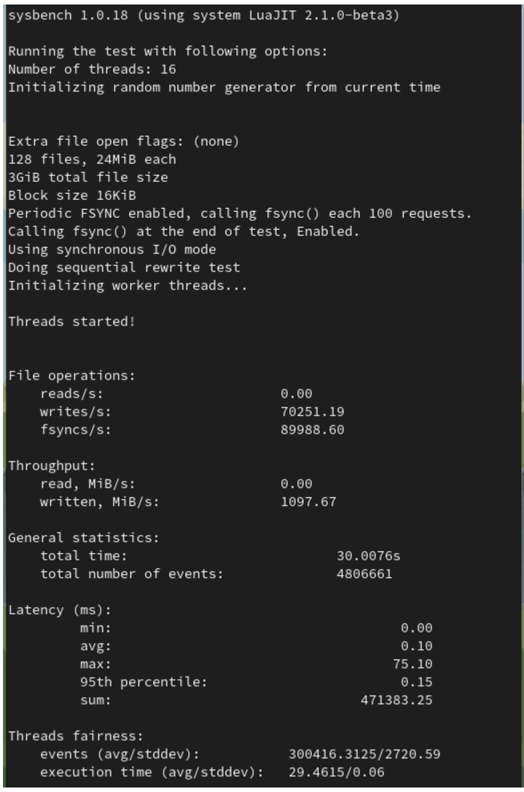
```
#scenario-2 : 4 GiB of RAM, 4 CPUs allocated
$ sudo docker run -it --cpus="4" --memory="4g" my_image_with_sysbench:latest
#test-case-05-io-seqrewr
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr cleanup
```



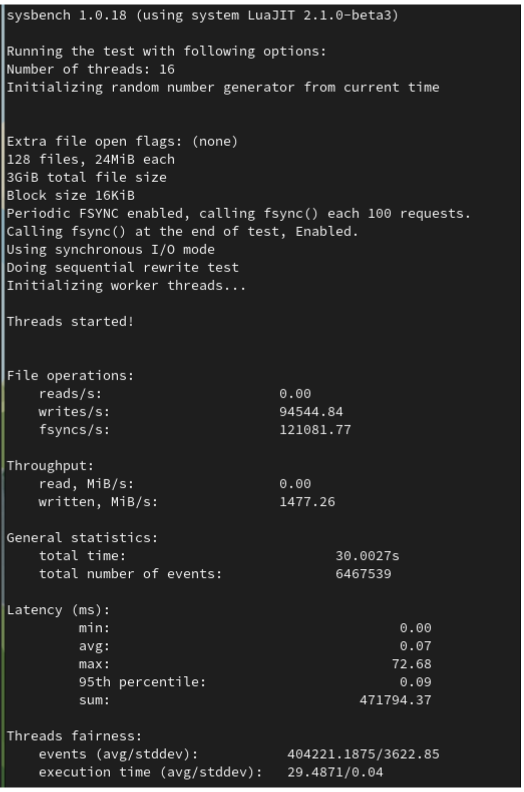
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     77637.75
    fsyncs/s:                     99442.19

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               1213.09

General statistics:
    total time:                          30.0020s
    total number of events:              5310860

Latency (ms):
         min:                                    0.00
         avg:                                    0.09
         max:                                   66.00
         95th percentile:                        0.13
         sum:                               471737.78

Threads fairness:
    events (avg/stddev):           331928.7500/4566.76
    execution time (avg/stddev):   29.4836/0.07
```



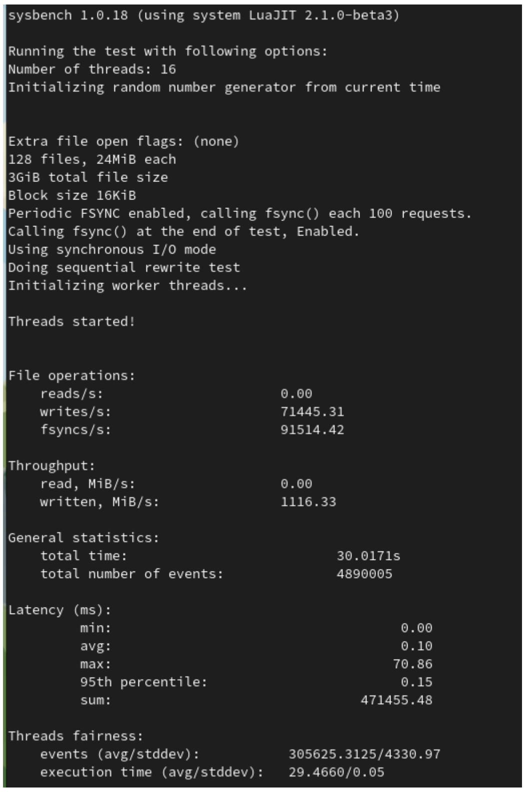
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     92047.52
    fsyncs/s:                     117885.93

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               1438.24

General statistics:
    total time:                          30.0029s
    total number of events:              6296750

Latency (ms):
         min:                                    0.00
         avg:                                    0.07
         max:                                   76.94
         95th percentile:                        0.09
         sum:                               471662.59

Threads fairness:
    events (avg/stddev):           393546.8750/3431.18
    execution time (avg/stddev):   29.4789/0.05
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     70251.19
    fsyncs/s:                     89988.60

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               1097.67

General statistics:
    total time:                          30.0076s
    total number of events:              4806661

Latency (ms):
         min:                                    0.00
         avg:                                    0.10
         max:                                   75.10
         95th percentile:                        0.15
         sum:                               471383.25

Threads fairness:
    events (avg/stddev):           300416.3125/2720.59
    execution time (avg/stddev):   29.4615/0.06
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     94544.84
    fsyncs/s:                     121081.77

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               1477.26

General statistics:
    total time:                          30.0027s
    total number of events:              6467539

Latency (ms):
         min:                                    0.00
         avg:                                    0.07
         max:                                   72.68
         95th percentile:                        0.09
         sum:                               471794.37

Threads fairness:
    events (avg/stddev):           404221.1875/3622.85
    execution time (avg/stddev):   29.4871/0.04
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     71445.31
    fsyncs/s:                     91514.42

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               1116.33

General statistics:
    total time:                          30.0171s
    total number of events:              4890005

Latency (ms):
         min:                                    0.00
         avg:                                    0.10
         max:                                   70.86
         95th percentile:                        0.15
         sum:                               471455.48

Threads fairness:
    events (avg/stddev):           305625.3125/4330.97
    execution time (avg/stddev):   29.4660/0.05
```

The following table shows the performance evaluations for test case scenario.

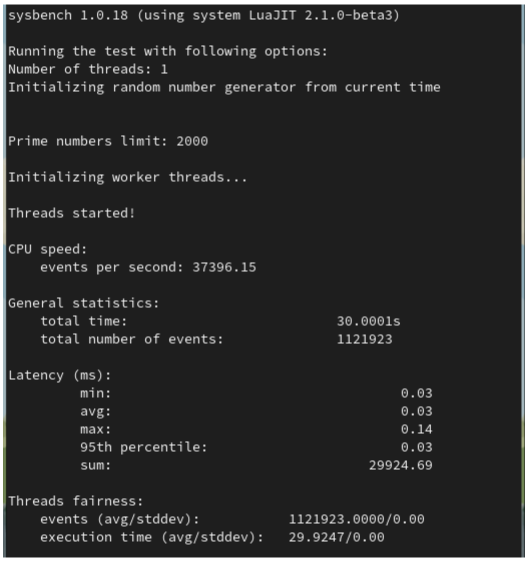
Iteration	writes/s	fsyncs/s	Throughput (written)
1	77637.75	99442.19	1213.09
2	92047.52	117885.93	1438.24

Iteration	writes/s	fsyncs/s	Throughput (written)
3	70251.19	89988.60	1097.67
4	94544.84	121081.77	1477.26
5	71445.31	91514.42	1116.33
average values	83184.66	105870.74	1306.44

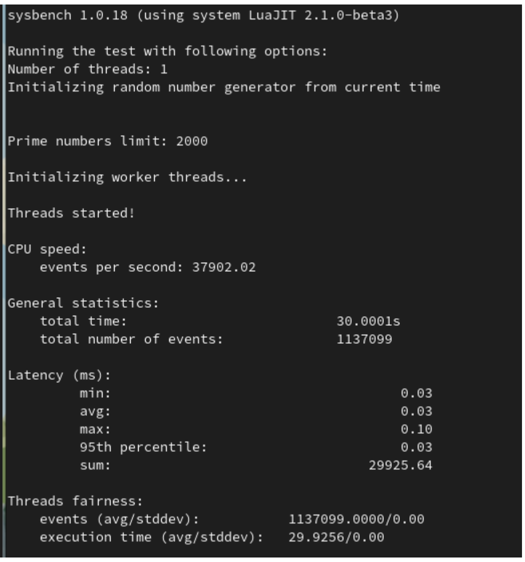
Scenario - 3 & Testcase - 1

These screenshots depict five iterations of testcase 1 in scenario 3 in Docker.

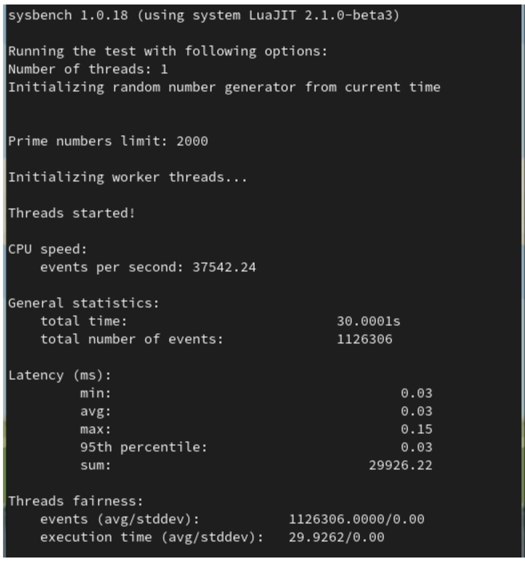
```
#scenario-3 : 8 GiB of RAM, 8 CPUs allocated
$ sudo docker run -it --cpus="8" --memory="8g" my_image_with_sysbench:latest
#test-case-01-cpu-2000
sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
```



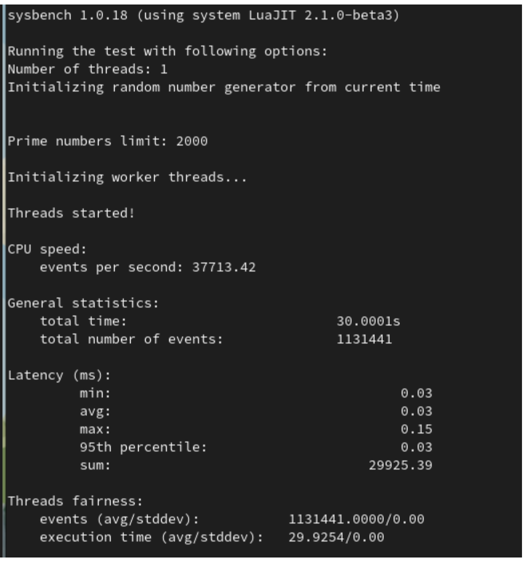
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37396.15

General statistics:
    total time:                          30.0001s
    total number of events:              1121923

Latency (ms):
         min:                                  0.03
         avg:                                  0.03
         max:                                  0.14
         95th percentile:                      0.03
         sum:                              29924.69

Threads fairness:
    events (avg/stddev):           1121923.0000/0.00
    execution time (avg/stddev):   29.9247/0.00
```



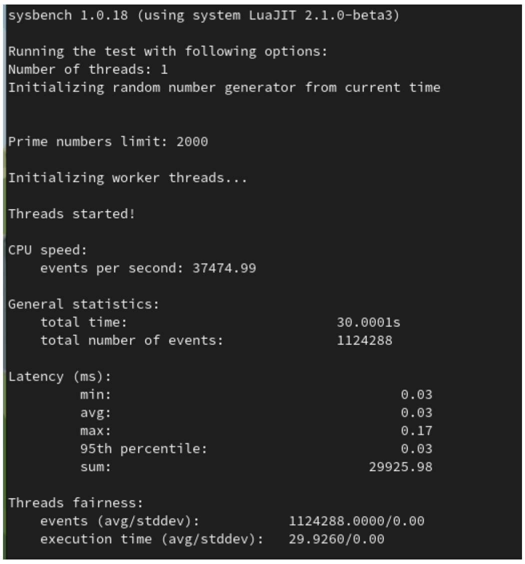
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37902.02

General statistics:
    total time:                          30.0001s
    total number of events:              1137099

Latency (ms):
         min:                                  0.03
         avg:                                  0.03
         max:                                  0.10
         95th percentile:                      0.03
         sum:                              29925.64

Threads fairness:
    events (avg/stddev):           1137099.0000/0.00
    execution time (avg/stddev):   29.9256/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37542.24

General statistics:
    total time:                          30.0001s
    total number of events:              1126306

Latency (ms):
         min:                                  0.03
         avg:                                  0.03
         max:                                  0.15
         95th percentile:                      0.03
         sum:                              29926.22

Threads fairness:
    events (avg/stddev):           1126306.0000/0.00
    execution time (avg/stddev):   29.9262/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37713.42

General statistics:
    total time:                          30.0001s
    total number of events:              1131441

Latency (ms):
         min:                                  0.03
         avg:                                  0.03
         max:                                  0.15
         95th percentile:                      0.03
         sum:                              29925.39

Threads fairness:
    events (avg/stddev):           1131441.0000/0.00
    execution time (avg/stddev):   29.9254/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 37474.99

General statistics:
    total time:                          30.0001s
    total number of events:              1124288

Latency (ms):
         min:                                    0.03
         avg:                                    0.03
         max:                                    0.17
         95th percentile:                        0.03
         sum:                                29925.98

Threads fairness:
    events (avg/stddev):           1124288.0000/0.00
    execution time (avg/stddev):   29.9260/0.00
```

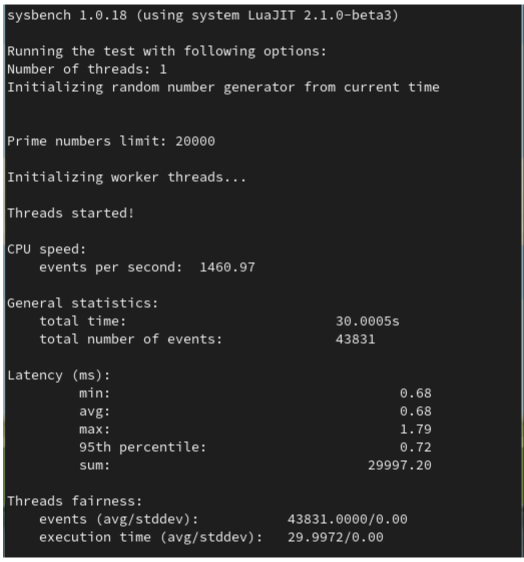
The following table shows the Events per second for test case scenario.

Iteration	**Events per second**
1	37396.15 (**MIN**)
2	37902.02 (**MAX**)
3	37542.24
4	37713.42
5	37474.99
Average Events per second	37605.76

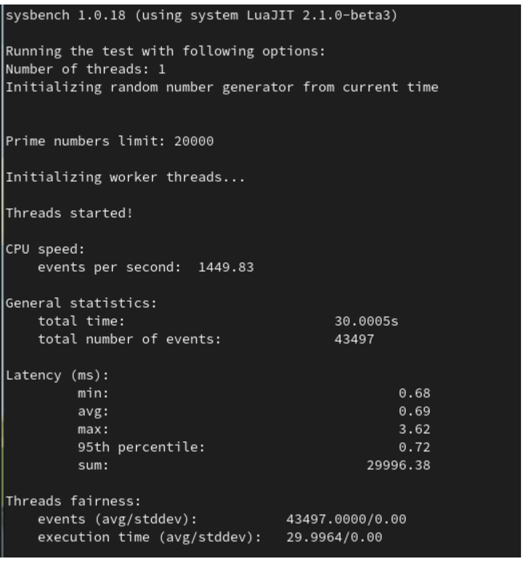
Scenario - 3 & Testcase - 2

These screenshots depict five iterations of testcase 2 in scenario 3 in Docker.

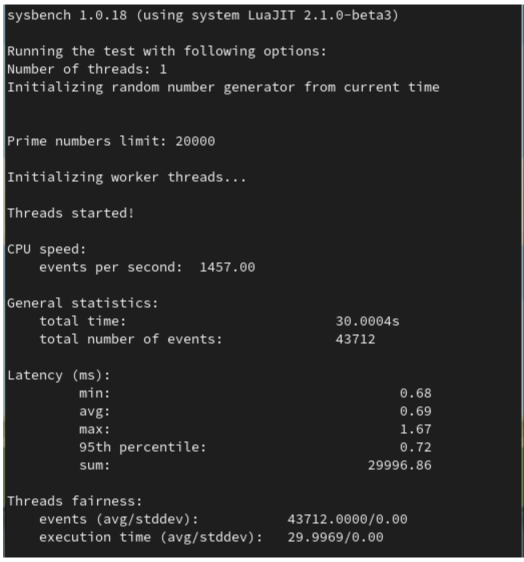
```
#scenario-3 : 8 GiB of RAM, 8 CPUs allocated
$ sudo docker run -it --cpus="8" --memory="8g" my_image_with_sysbench:latest
#test-case-02-cpu-20000
sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
```



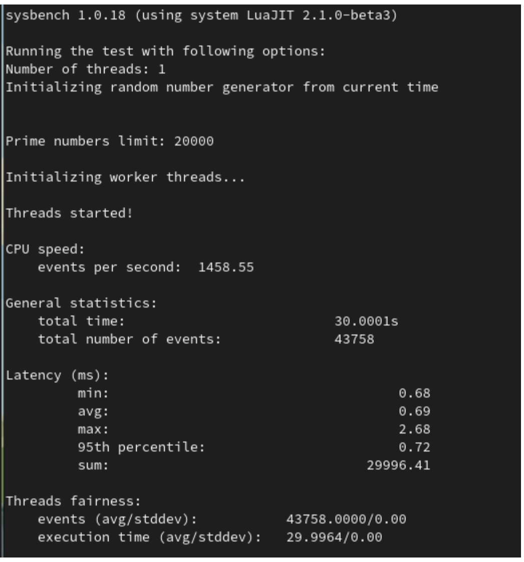
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1460.97

General statistics:
    total time:                          30.0005s
    total number of events:              43831

Latency (ms):
         min:                                    0.68
         avg:                                    0.68
         max:                                    1.79
         95th percentile:                        0.72
         sum:                                29997.20

Threads fairness:
    events (avg/stddev):           43831.0000/0.00
    execution time (avg/stddev):   29.9972/0.00
```



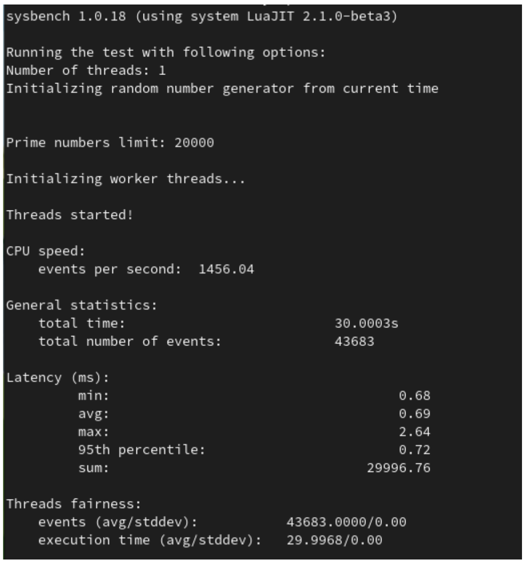
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1449.83

General statistics:
    total time:                          30.0005s
    total number of events:              43497

Latency (ms):
         min:                                    0.68
         avg:                                    0.69
         max:                                    3.62
         95th percentile:                        0.72
         sum:                                29996.38

Threads fairness:
    events (avg/stddev):           43497.0000/0.00
    execution time (avg/stddev):   29.9964/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1457.00

General statistics:
    total time:                          30.0004s
    total number of events:              43712

Latency (ms):
         min:                                    0.68
         avg:                                    0.69
         max:                                    1.67
         95th percentile:                        0.72
         sum:                                29996.86

Threads fairness:
    events (avg/stddev):           43712.0000/0.00
    execution time (avg/stddev):   29.9969/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1458.55

General statistics:
    total time:                          30.0001s
    total number of events:              43758

Latency (ms):
         min:                                    0.68
         avg:                                    0.69
         max:                                    2.68
         95th percentile:                        0.72
         sum:                                29996.41

Threads fairness:
    events (avg/stddev):           43758.0000/0.00
    execution time (avg/stddev):   29.9964/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:  1456.04

General statistics:
    total time:                          30.0003s
    total number of events:              43683

Latency (ms):
         min:                                    0.68
         avg:                                    0.69
         max:                                    2.64
         95th percentile:                        0.72
         sum:                                29996.76

Threads fairness:
    events (avg/stddev):           43683.0000/0.00
    execution time (avg/stddev):   29.9968/0.00
```

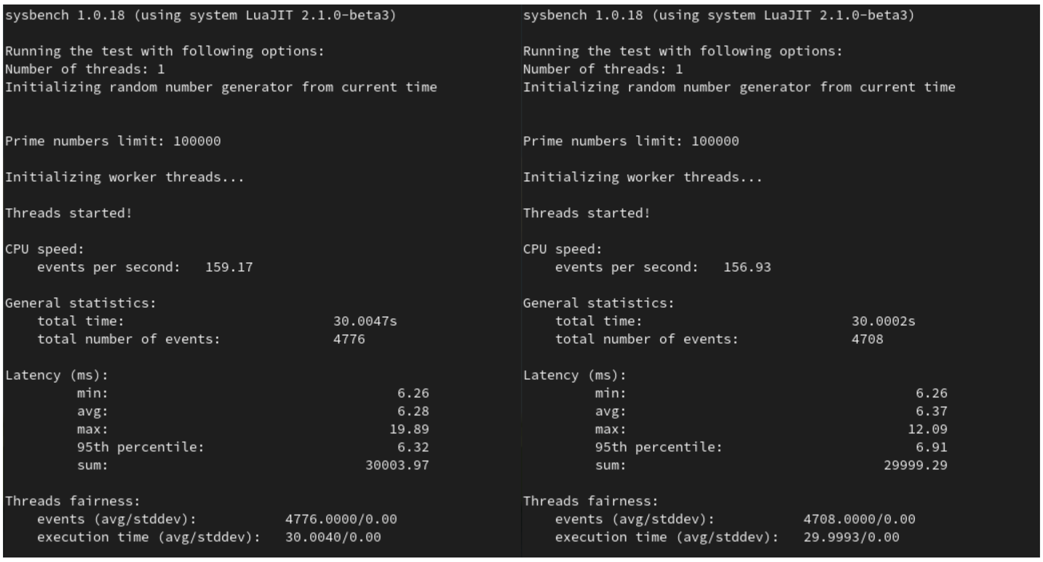
The following table shows the Events per second for test case scenario.

Iteration	Events per second
1	1460.97 (**MAX**)
2	1449.83 (**MIN**)
3	1457.00
4	1458.55
5	1456.04
Average Events per second	1456.47

Scenario - 3 & Testcase - 3

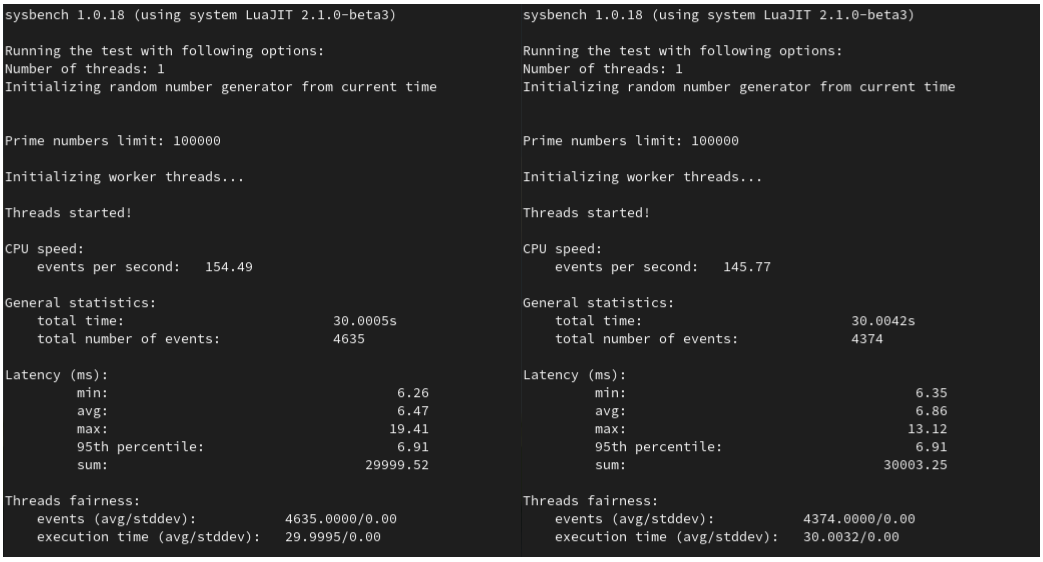
These screenshots depict five iterations of testcase 3 in scenario 3 in Docker.

```
#scenario-3 : 8 GiB of RAM, 8 CPUs allocated
$ sudo docker run -it --cpus="8" --memory="8g" my_image_with_sysbench:latest
#test-case-03-cpu-100000
sysbench --test=cpu --cpu-max-prime=100000 --time=30 run
```



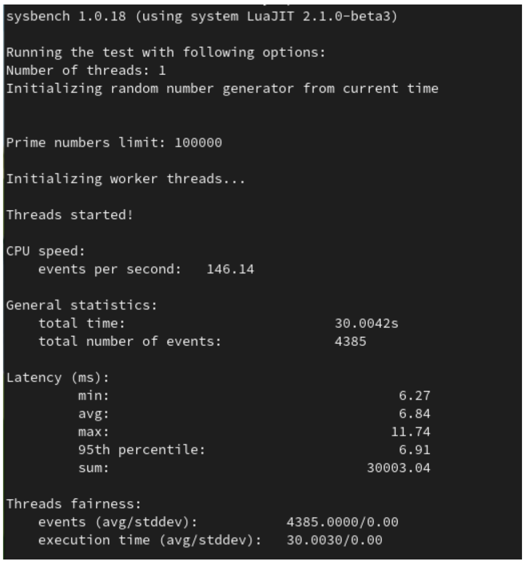
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   159.17

General statistics:
    total time:                          30.0047s
    total number of events:              4776

Latency (ms):
         min:                                    6.26
         avg:                                    6.28
         max:                                   19.89
         95th percentile:                        6.32
         sum:                                30003.97

Threads fairness:
    events (avg/stddev):           4776.0000/0.00
    execution time (avg/stddev):   30.0040/0.00
```

```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   156.93

General statistics:
    total time:                          30.0002s
    total number of events:              4708

Latency (ms):
         min:                                    6.26
         avg:                                    6.37
         max:                                   12.09
         95th percentile:                        6.91
         sum:                                29999.29

Threads fairness:
    events (avg/stddev):           4708.0000/0.00
    execution time (avg/stddev):   29.9993/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   154.49

General statistics:
    total time:                          30.0005s
    total number of events:              4635

Latency (ms):
         min:                                    6.26
         avg:                                    6.47
         max:                                   19.41
         95th percentile:                        6.91
         sum:                                29999.52

Threads fairness:
    events (avg/stddev):           4635.0000/0.00
    execution time (avg/stddev):   29.9995/0.00
```

```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   145.77

General statistics:
    total time:                          30.0042s
    total number of events:              4374

Latency (ms):
         min:                                    6.35
         avg:                                    6.86
         max:                                   13.12
         95th percentile:                        6.91
         sum:                                30003.25

Threads fairness:
    events (avg/stddev):           4374.0000/0.00
    execution time (avg/stddev):   30.0032/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 100000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   146.14

General statistics:
    total time:                          30.0042s
    total number of events:              4385

Latency (ms):
         min:                                    6.27
         avg:                                    6.84
         max:                                   11.74
         95th percentile:                        6.91
         sum:                                30003.04

Threads fairness:
    events (avg/stddev):           4385.0000/0.00
    execution time (avg/stddev):   30.0030/0.00
```

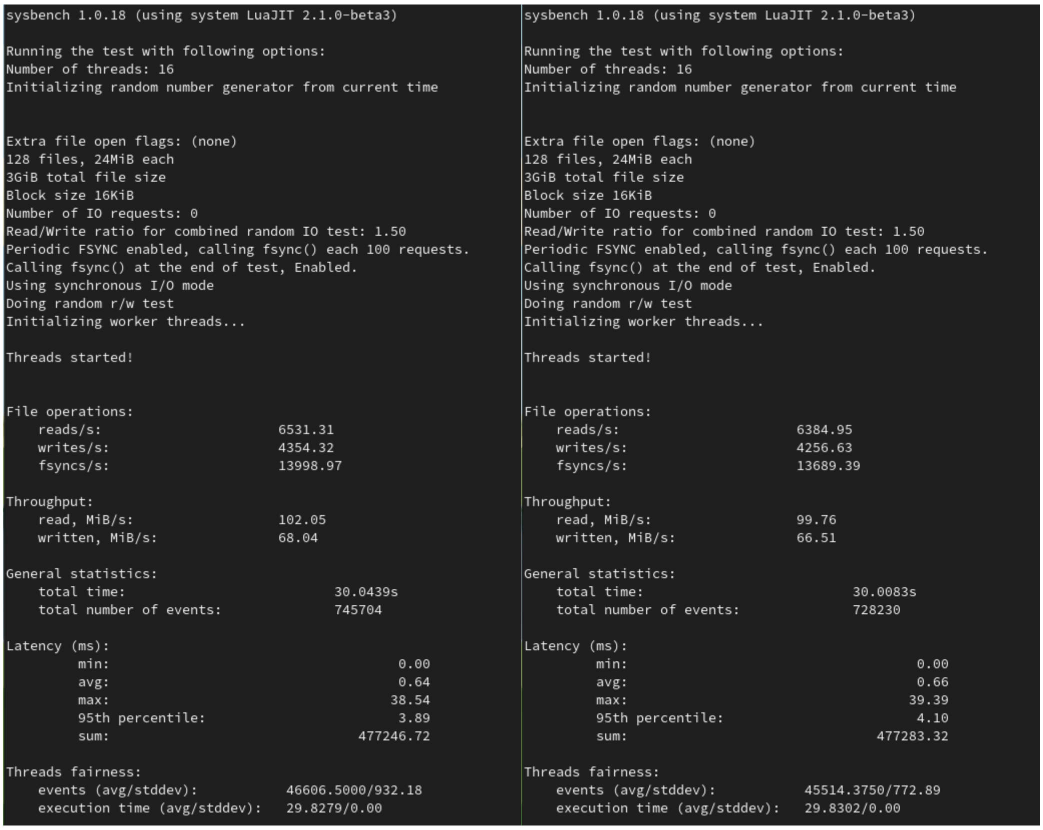
The following table shows the Events per second for test case scenario.

Iteration	**Events per second**
1	159.17 (**MAX**)
2	156.93
3	154.49
4	145.77 (**MIN**)
5	146.14
Average Events per second	152.5

Scenario - 3 & Testcase - 4

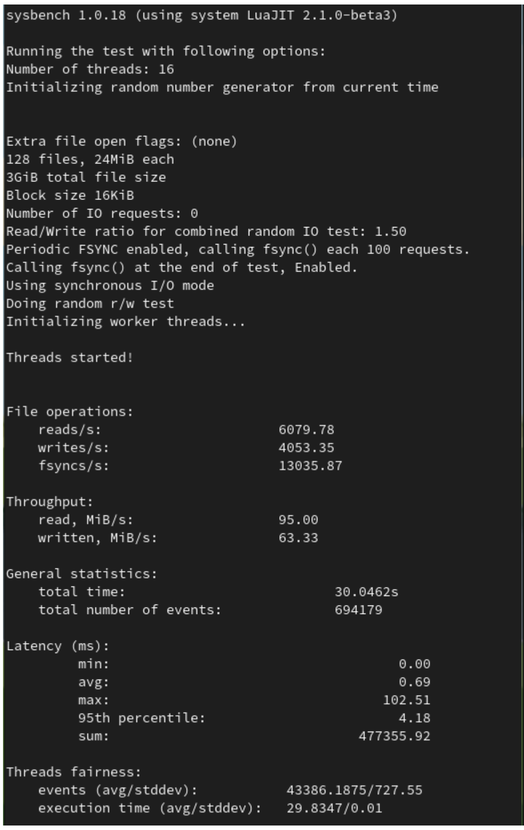
These screenshots depict five iterations of testcase 4 in scenario 3 in Docker.

```
#scenario-3 : 8 GiB of RAM, 8 CPUs allocated
$ sudo docker run -it --cpus="8" --memory="8g" my_image_with_sysbench:latest
#test-case-04-io-rndrw
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw cleanup
```

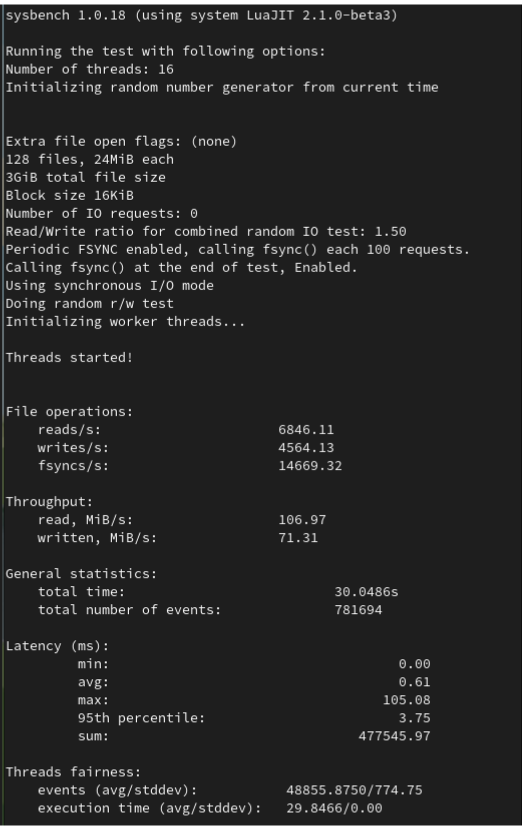


```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      6531.31
    writes/s:                     4354.32
    fsyncs/s:                     13998.97

Throughput:
    read, MiB/s:                  102.05
    written, MiB/s:               68.04

General statistics:
    total time:                          30.0439s
    total number of events:              745704

Latency (ms):
         min:                                    0.00
         avg:                                    0.64
         max:                                   38.54
         95th percentile:                        3.89
         sum:                               477246.72

Threads fairness:
    events (avg/stddev):           46606.5000/932.18
    execution time (avg/stddev):   29.8279/0.00
```

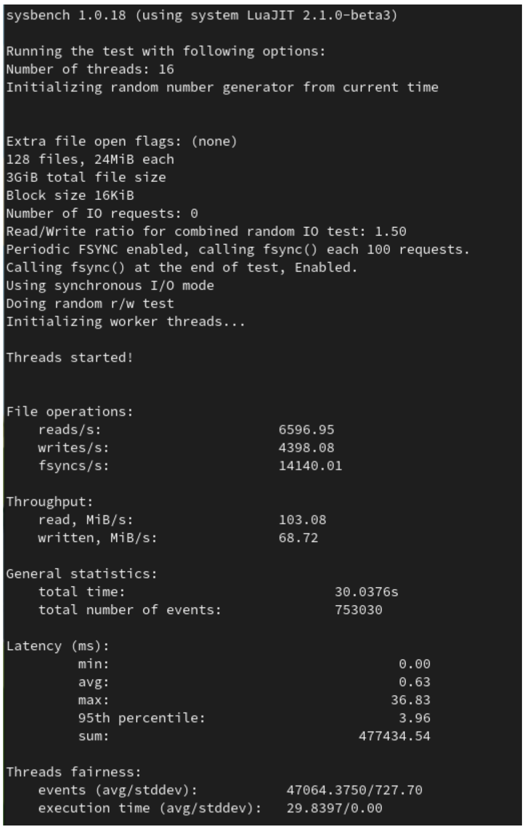
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      6384.95
    writes/s:                     4256.63
    fsyncs/s:                     13689.39

Throughput:
    read, MiB/s:                  99.76
    written, MiB/s:               66.51

General statistics:
    total time:                          30.0083s
    total number of events:              728230

Latency (ms):
         min:                                    0.00
         avg:                                    0.66
         max:                                   39.39
         95th percentile:                        4.10
         sum:                               477283.32

Threads fairness:
    events (avg/stddev):           45514.3750/772.89
    execution time (avg/stddev):   29.8302/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      6079.78
    writes/s:                     4053.35
    fsyncs/s:                     13035.87

Throughput:
    read, MiB/s:                  95.00
    written, MiB/s:               63.33

General statistics:
    total time:                          30.0462s
    total number of events:              694179

Latency (ms):
         min:                                    0.00
         avg:                                    0.69
         max:                                  102.51
         95th percentile:                        4.18
         sum:                               477355.92

Threads fairness:
    events (avg/stddev):           43386.1875/727.55
    execution time (avg/stddev):   29.8347/0.01
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      6846.11
    writes/s:                     4564.13
    fsyncs/s:                     14669.32

Throughput:
    read, MiB/s:                  106.97
    written, MiB/s:               71.31

General statistics:
    total time:                          30.0486s
    total number of events:              781694

Latency (ms):
         min:                                    0.00
         avg:                                    0.61
         max:                                  105.08
         95th percentile:                        3.75
         sum:                               477545.97

Threads fairness:
    events (avg/stddev):           48855.8750/774.75
    execution time (avg/stddev):   29.8466/0.00
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      6596.95
    writes/s:                     4398.08
    fsyncs/s:                     14140.01

Throughput:
    read, MiB/s:                  103.08
    written, MiB/s:               68.72

General statistics:
    total time:                          30.0376s
    total number of events:              753030

Latency (ms):
         min:                                    0.00
         avg:                                    0.63
         max:                                   36.83
         95th percentile:                        3.96
         sum:                               477434.54

Threads fairness:
    events (avg/stddev):           47064.3750/727.70
    execution time (avg/stddev):   29.8397/0.00
```

The following table shows the performance evaluations for test case scenario.

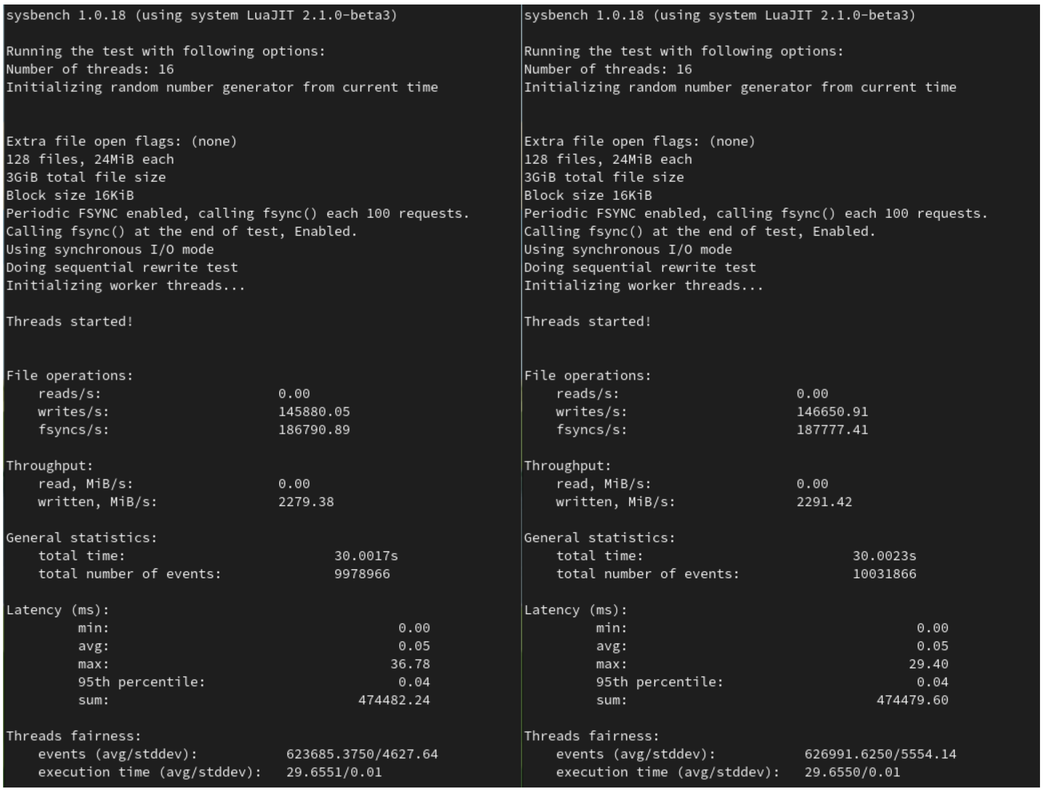
Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
1	6531.31	4354.32	13998.97	102.05	68.04

Iteration	reads/s	writes/s	fsyncs/s	throughput (read)	written
2	6384.95	4256.63	13689.39	99.76	66.51
3	6079.78	4053.35	13035.87	95.00	63.33
4	6846.11	4564.13	14669.32	106.97	71.31
5	6596.95	4398.08	14140.01	103.08	68.72
average values	6386.72	4338.05	13875.28	100.51	67.52

Scenario - 3 & Testcase - 5

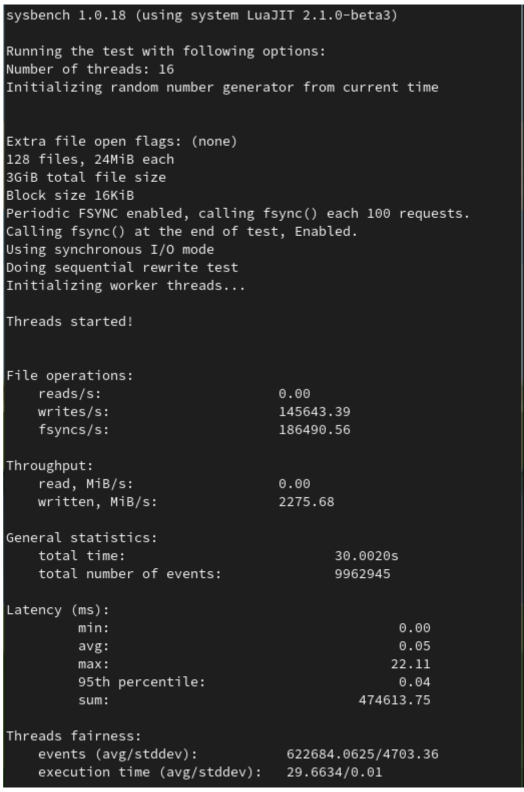
These screenshots depict five iterations of testcase 5 in scenario 3 in Docker.

```
#scenario-3 : 8 GiB of RAM, 8 CPUs allocated
$ sudo docker run -it --cpus="8" --memory="8g" my_image_with_sysbench:latest
#test-case-05-io-seqrewr
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr prepare
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr run
sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=seqrewr cleanup
```

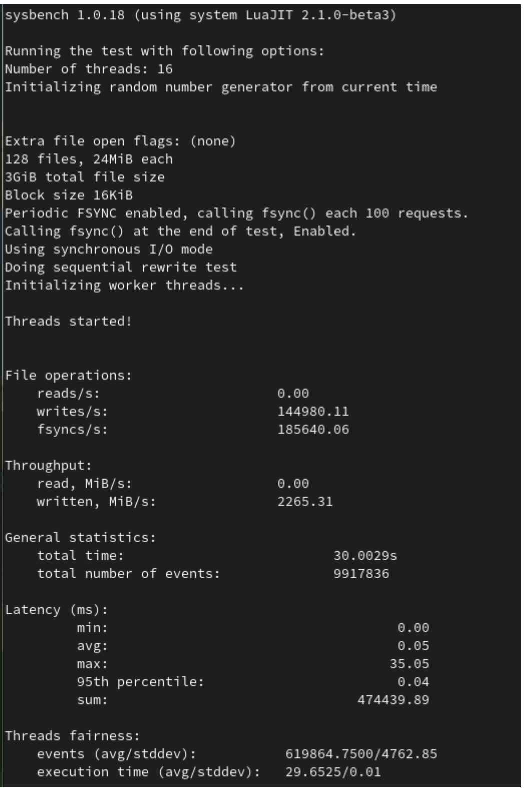


```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     145880.05
    fsyncs/s:                     186790.89

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               2279.38

General statistics:
    total time:                          30.0017s
    total number of events:              9978966

Latency (ms):
         min:                                    0.00
         avg:                                    0.05
         max:                                   36.78
         95th percentile:                        0.04
         sum:                               474482.24

Threads fairness:
    events (avg/stddev):           623685.3750/4627.64
    execution time (avg/stddev):   29.6551/0.01
```

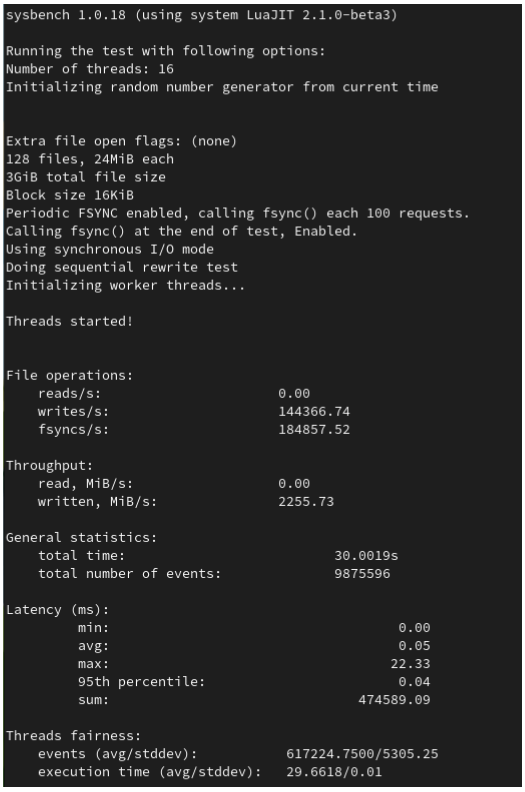
```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     146650.91
    fsyncs/s:                     187777.41

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               2291.42

General statistics:
    total time:                          30.0023s
    total number of events:              10031866

Latency (ms):
         min:                                    0.00
         avg:                                    0.05
         max:                                   29.40
         95th percentile:                        0.04
         sum:                               474479.60

Threads fairness:
    events (avg/stddev):           626991.6250/5554.14
    execution time (avg/stddev):   29.6550/0.01
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     145643.39
    fsyncs/s:                     186490.56

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               2275.68

General statistics:
    total time:                          30.0020s
    total number of events:              9962945

Latency (ms):
         min:                                    0.00
         avg:                                    0.05
         max:                                   22.11
         95th percentile:                        0.04
         sum:                               474613.75

Threads fairness:
    events (avg/stddev):           622684.0625/4703.36
    execution time (avg/stddev):   29.6634/0.01
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     144980.11
    fsyncs/s:                     185640.06

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               2265.31

General statistics:
    total time:                          30.0029s
    total number of events:              9917836

Latency (ms):
         min:                                    0.00
         avg:                                    0.05
         max:                                   35.05
         95th percentile:                        0.04
         sum:                               474439.89

Threads fairness:
    events (avg/stddev):           619864.7500/4762.85
    execution time (avg/stddev):   29.6525/0.01
```



```
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     144366.74
    fsyncs/s:                     184857.52

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               2255.73

General statistics:
    total time:                          30.0019s
    total number of events:              9875596

Latency (ms):
         min:                                    0.00
         avg:                                    0.05
         max:                                   22.33
         95th percentile:                        0.04
         sum:                               474589.09

Threads fairness:
    events (avg/stddev):           617224.7500/5305.25
    execution time (avg/stddev):   29.6618/0.01
```

The following table shows the performance evaluations for test case scenario.

Iteration	writes/s	fsyncs/s	Throughput (written)
1	145880.05	186790.89	2279.38
2	146650.91	187777.41	2291.42

Iteration	writes/s	fsyncs/s	Throughput (written)
3	145643.39	186490.56	2275.68
4	144980.11	185640.06	2265.31
5	144366.74	184857.52	2255.73
average values	145505.23	186244.62	2274.57

Conclusions

After an extensive evaluation of the benchmarking results, it can be concluded that scenario 3 in both the system virtualization (QEMU) and OS virtualization (Docker) offered the highest level of performance when compared to the other two scenarios.

In terms of CPU utilization, the OS virtualization provided slightly better results than the system virtualization. However, when it came to disk utilization, specifically in terms of file I/O, the OS virtualization outperformed the system virtualization significantly.

These findings indicate that while both virtualization approaches have their strengths and weaknesses, in this particular scenario, the OS virtualization offered a higher level of performance.

It is important to note that this conclusion was drawn based on a specific set of criteria and benchmarking data. The results may differ in other scenarios, depending on the system specifications, configuration, and usage patterns. Thus, it is recommended to evaluate virtualization options on a case-by-case basis, considering the specific needs and requirements of the system.

Overall, this report serves as a valuable resource for those seeking to understand the relative performance of system virtualization and OS virtualization. The results can be used to make informed decisions regarding the selection and deployment of virtualization technology in different scenarios.

Github Repository Information

Repository name : cloud-class

https://github.com/rahulyal/cloud-class.git