SYSmark® 30

An Overview of SYSmark 30

Revision History:

1.0 Initial release.
1.1 Updated minimum requirements.
1.2 Updated Individual results for sub scenarios are valid in scores section page 14.

About BAPCo

Business Applications Performance Corporation (BAPCo®) is a non-profit consortium with a charter to develop and distribute a set of objective performance benchmarks for personal computers based on popular computer applications and industry standard operating systems.

For more information about BAPCo or a complete list of the current membership, see our website at http://www.bapco.com.

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1 Introduction

SYSmark® 30 is the latest version of the premier performance qualified battery life benchmark for mobile PCs. It features real world applications, updated workloads, and support for Microsoft Windows® 11 64 bit (build 194 or higher; SV2 22621.521 or higher), and Windows 10 64 bit (19H2 or higher).

SYSmark 30 gives commercial and government IT decision makers, retailers, media, channel buyers, consultants, component designers, hardware designers, and manufacturers an objective, easy-to-use tool to evaluate the performance-of PCs across the wide range of activities that a user may encounter.

SYSmark 30 is designed for those who want to:

- Evaluate and compare Windows x64-based PC devices on performance differentiating workloads.
- Provide useful information to their audience(s) to assist in the evaluation and purchase of these devices.
- Evaluate PC devices to better tune & optimize for best user experience.

Unlike synthetic benchmarks, which artificially stress PC components or attempt to model performance using a static simulation of application behavior, SYSmark 30 is application based, employs data sets like those users would encounter in a business environment, and provides a system level view of PC performance.

This document describes the methodologies employed in the development of SYSmark 30. For detailed instructions on how to install and run SYSmark 30, refer to the user guide posted at www.bapco.com/products/sysmark-30.

2 BAPCo Development Process

BAPCo creates benchmarks in accordance with the BAPCo Development Process, a set of milestones and checkpoints collaboratively developed and agreed upon by the BAPCo membership.

At the start of benchmark product development, BAPCo members identify PC usage models that are common in business environments. Similar usage models are aggregated into groups called scenarios and arranged in a workflow that follows what actual PC users do on their systems. Once the usages models and scenario grouping are finalized, BAPCo relies on market research to select the applications to include in the benchmark. From time to time, technical hurdles may prevent BAPCo from including a particular application or specific application version, but BAPCo strives to include the latest version of market leading applications available at the time of benchmark development. .

With the usage models and applications selection milestones closed, BAPCo members meet at the BAPCo Development Conference (BDC) to participate in workload development sessions. Member companies send their BAPCo representatives to the BDC along with application subject matter experts (SME) who provide consultation and guidance to the membership as the workload content is created.

The content for each application workload consists of three elements: the input data set, the tasks performed on the input data set, and the generated output. The application subject matter experts assist the membership with gathering the appropriate content (such as a set of photos for an HDR workload) and creating a workflow in the target application for inclusion in the benchmark. BAPCo developers work with the SMEs to document the data set and workflow specifications into design documents. At the conclusion of the BDC, BAPCo developers refer to the design documents to implement the Committee's design choices while adhering to benchmarking constraints, product stability requirements, and ensuring consistent, repeatable results.

2.1 Milestone Overview

The BAPCo development process is divided into six major phases (Initialization, Design and Planning, Implementation, Validation, Characterization and Launch). Each phase consists of a series of milestones, some of which may be worked on concurrently.

The membership must vote to close each milestone. Once all the milestones within a phase are complete, the membership must vote to exit the current phase and enter the next phase. BAPCo members work in a collaborative process where decisions regarding products are sometimes made by majority vote rather than unanimously.

The following is the list of the development phases and the corresponding milestones. Some of these milestones are explained in greater detail in the following sections, as noted in this list.

1. Initialization Phase
    a. Milestone 1 – Committee kickoff
    b. Milestone 2 – Benchmark market and customer analysis
    c. Milestone 3 – Product positioning and customer value proposition
    d. Milestone 4 – Preliminary marketing requirements document
    e. Milestone 5 – Final marketing requirements document
2. Design and Planning Phase
    a. Milestone 6 – Preliminary engineering requirements document
    b. Milestone 7 – Usage model selection (see section 2.2)
    c. Milestone 8 – Application selection (see section 2.3)
    d. Milestone 9 – Define member resource commitments
    e. Milestone 10 – Define development infrastructure
    f. Milestone 11 – Define scoring methodology (see section 2.4)
    g. Milestone 12 – Define application/API licensing requirements

   h. Milestone 13 – Plan and execute workload development sessions (see section 2.5)
   i. Milestone 14 – Define product release criteria
3. Implementation Phase
   a. Milestone 15 – Create implementation schedule
   b. Milestone 16 – Determine reference system (see section 2.7)
   c. Milestone 17 – Software engineering
4. Validation Phase
   a. Milestone 18 – Validation testing
   b. Milestone 19 – Define risk management plan
5. Characterization Phase
   a. Milestone 20 – Characterization testing
6. Launch Phase
   a. Milestone 21 – Product pricing
   b. Milestone 22 – Pre-launch materials
   c. Milestone 23 – Release to manufacture vote and sign-off
   d. Milestone 24 – Distribute early press evaluation
   e. Milestone 25 – Duplicate and distribute media
   f. Milestone 26 – Post-launch materials

2.2 Usage Model/Scenario Selection

In Milestone 6 of the BAPCo Development Process, usage models are chosen for inclusion in the final benchmark product. For SYSmark 30, BAPCo chose a wide variety of usage models in which the user experience is influenced by system performance. BAPCo categorizes the usages models into groups called scenarios; SYSmark 30 has four scenarios. Running all four scenarios will produce a scenario rating for each scenario, along with an overall score. Users also have the option to select individual scenarios for execution, however, if the overall score is not produced the result is not valid for submission at results.bapco.com. For more information on scoring, see section 2.4. For more information on how to execute benchmark runs, please refer to the SYSmark 30 user guide posted at www.bapco.com/products/sysmark-30.

Office applications

The Office Applications scenario models using common Microsoft Office applications such as MS, Word, MS Excel, and MS PowerPoint, to accomplish tasks such as PDF conversion, mail merge, financial forecasting and presentation creation. MS Outlook is launched and remains open throughout the scenario for ambient load.

General Productivity

The General Productivity scenario models productivity tasks such as application installation, working with OCR documents, creating and unpacking zip archives, and web browsing.

Photo Editing

The Photo Editing scenario models editing digital photos (creating HDR), cataloging digital photos (organizing a catalog, use of facial detection to group people),

Advanced Content Creation

The Advanced Content Creation scenario includes a multitasking workload. A video encode is started in Adobe Premiere and sent to the background while Adobe Photoshop is launched and used to manipulate photos in the foreground. Due to the way operating systems handle multitasking events, slight run to run variation may be present in the Advanced Content Creation scenario score.

2.3 Application Selection

In milestone 7, after the usage models are collected into scenarios, applications are chosen for the scenarios based on market research and technical feasibility.

Sufficient lead time is needed after the applications are selected for BAPCo to develop workloads, integrate the applications into the benchmark, and perform validation of the benchmark. Therefore, some of the application versions are not the latest available at the time of the launch of SYSmark 30.

The criteria that BAPCo uses for application selection includes, but is not limited to:

- Ability of the application to perform the needed task
- Applications with broad install base
- Minimum system requirements of the application
- Hardware support of the application
- Diversity of application vendors

For SYSmark 30, BAPCo has identified the following representative applications for the four usage scenarios.

The following applications (grouped by scenario) are installed and/or used by SYSmark 30. Some applications appear in multiple scenarios, but only one instance of the application is installed.

Office Applications

- Microsoft® Excel® 2021 Professional Plus VL
- Microsoft® Outlook® 2021 Professional Plus VL
- Microsoft® PowerPoint® 2021 Professional Plus VL
- Microsoft® Word® 2021 Professional Plus VL

General Productivity

- Adobe® Acrobat® Pro DC
- Audacity (v 2.3.2) (for app install)
- Corel WinZip 26.0
- Google Chrome (v 106.0.5249.103)

Photo Editing

- Adobe® Lightroom® Classic (version 11)
- Adobe® Photoshop® CC (version 23)

Advanced Content Creation

- Adobe® Photoshop® CC (version 23)
- Adobe® Premiere® CC (version 22)

Please note some of these applications have licensing restrictions which cause them to expire after 30 days. BAPCo recommends creating a backup of the system under test clean OS image prior to installing SYSmark 30. If the SYSmark installation expires, restore the OS from the back up image, and reinstall SYSmark 30 to continue testing for another 30-day period.

2.4 Scoring Methodology

In milestone 11, BAPCo decides the types of results produced by a benchmark and the scoring methodology that determines how those results are calculated.

Importantly, BAPCo determines the scoring methodology before determining the content of the workloads, which helps ensure that the scoring methodology is chosen for its ability to generate results that correspond to user experience, not for the results it produces on a pre-determined set of workloads.

For SYSmark 30, BAPCo evaluated the merits of a variety of scoring methodologies and chose a methodology based on how it met the following criteria:

- The scoring methodology should give expected results:
  - The resulting score should differentiate between systems with different performance.
  - The resulting score should be repeatable and not have high variation.
  - The resulting score should not be affected by benchmark artifacts, such as the number of tasks within a scenario.
- The relative performance between any two systems should not be affected by the selection of the calibration system.
- The resulting score should reflect the performance of user initiated multitasking operations.
- The scoring methodology should be easy to understand.

SYSmark 30 evaluates system performance by measuring the response time of tasks on a PC using real applications and simulated user input. In the SYSmark 30 scoring methodology, task response times are used to generate performance rating that reflects the user experience. The faster a PC responds to the application workloads in SYSmark 30, the higher its SYSmark 30 performance rating will be.

SYSmark 30 scores

SYSmark 30 outputs the four scores described below. All scores are relative to the calibration system, which scores a value of 1000 for each scenario rating and the overall score. Therefore, a SUT scoring 2000 will have outperformed the calibration system by a factor of 2x for that scenario rating or overall score. See section 2.7 for additional details on the calibration system

- Overall performance

  The overall score is produced only if all four scenarios are executed and is calculated by taking the geomean of the four scenario ratings. See formula below, where S_1...S_4, represent each scenario rating value. If multiple iterations were executed during the benchmark project, the scenario rating is the average of the number of iterations executed for that scenario.

$$Overall\ score = \sqrt[4]{S_1 * S_2 * S_3 * S_4}$$

  If three or less scenarios were executed, the Overall score will be marked N/A. Individual results for sub scenarios are valid for submission at results.bapco.com.

Scenario ratings:

- Office Applications (OA)
- General Productivity (GP)
- Photo Editing (PE)
- Advanced Content Creation (CC)

The scenario ratings are calculated with the following formula:

$$Scenario\ rating = \left(\frac{Scenairo\ Run\ time\ on\ Calibration}{Scenario\ Run\ time\ on\ SUT}\right) * 1000$$

2.5 Workload Development Sessions

Once the usage models, scenarios, application models, and scoring methodology for the benchmark are decided, BAPCo members and application experts meet to create the application workloads that will be used in the benchmark.

For SYSmark 30, the workload development sessions consisted of one week of faceto-face meetings that included representatives from BAPCo member companies and expert application users who had professional experience with the applications chosen for the benchmark. The application experts included professionals in small business marketing, financial forecasting, graphic design, video editing, web development, and enterprise IT deployment.

In the workload development sessions, the experts take the lead, integrating the usage models supplied by BAPCo into a storyboard of user interactions with a series of application models. Each user interaction is written down in a workload specification, which is later used to automate the workloads.

At the end of the workload development sessions, BAPCo comes away with a detailed workload specification for each of the benchmark scenarios and all the input data sets needed to reproduce the workloads created at the sessions.

Additional Workload Considerations

The following additional factors were considered at the workload development sessions:

Input Data Set

The data

Frequently in the sessions, the experts need raw digital content to serve as input data set for a workload. Examples of such content might include a video to transcode, an email to modify, or photos to manipulate. When experts need such content, care is taken to ensure that they use something that is functionally representative of content they might use or encounter professionally.

For instance, if pictures are needed to create a photo slideshow, an expert might walk outside and take pictures using the same equipment he/she uses professionally. If a song track is needed as the background music for creating a movie, an expert might purchase a stock track from his/her usual online resource. Like the user interactions, all of these source materials are captured at the development session and used later in the development of automated workloads.

2.6 Scenario Workload Descriptions

The scenario workloads created at the workload development sessions for SYSmark 30 are described below:

Office Applications

The Office Applications scenario models office environment like usage including word processing (mail merge, document comparison, and PDF conversion), spreadsheet data manipulation (data modeling, financial forecasting), presentation editing.

General Productivity

The General Productivity scenario models OCR of documents, web browsing, application installation, and archiving and unpacking a mixed file data set.

Photo Editing

The Photo Editing scenario models editing digital photos (applying filters and creating HDR photos), cataloging digital photos (organizing catalog, use of facial detection to group people).

Advanced Content Creation

The Advanced Content Creation scenario encodes video with a CPU render and GPU accelerated workload for SUTs configured with a supported accelerated GPU. A multitasking workload switches between photo editing and video editing workloads.

2.7 Calibration System

The calibration system is a system chosen in Milestone 16 as a reference point for all other SYSmark 30 results. BAPCo chose the configuration below for its wide availability and its representation of a typical mainstream desktop computer at the time of release of SYSmark 30.

SYSmark 30 is calibrated in such a way that a desktop computer with performance equivalent to this calibration system for a given workload will have an overall rating and scenario performance rating of 1000. A system twice as fast as the calibration system on a given workload (or, equivalently, that responds in half the time on average) will have a scenario performance rating of 2000. This is true for the overall score and each of the scenario performance ratings.

Lenovo® ThinkCentre™ M720q

- CPU: 11th Gen Intel Core i5 11400T
- Graphics: Intel UHD 730
- Resolution: 1920x1080
- OS: Win 11 21H2 build 10.0.22000.318 (64-bit)
- RAM: 2x8GB, 16GB dual channel
- Storage: 512GB PCIE OPAL2

For more details about the configuration of the calibration system, please contact support@bapco.com.

2.8 Benchmark Implementation

Once the workload specifications are created, BAPCo begins the work of translating the workload specifications into an automated benchmark in milestone 17.

SYSmark 30 is built upon scripts that do things in much the same way as a user would, using controls like buttons, text input boxes, and menus to navigate applications. See Appendix C for screenshots of the benchmark in action.

To ensure that SYSmark 30 has deterministic behavior, BAPCo uses a framework to install applications, collect system information, run the scenario scripts, record performance measurements, calculate performance ratings, and display test results. The framework is kept lightweight, consuming a minimal amount of memory and compute resources, to ensure that battery life and performance measurements reflect the workload behavior and do not include overhead from the framework.

The fundamental performance unit upon which the SYSmark 30 Performance Rating is based is *response time*. Response time is defined as the time it takes the computer to complete a task that has been initiated by the automated script. A task can be initiated by a mouse click or a keystroke. The duration of each task is measured by the framework. Examples of tasks include launching an application, finding text in a document, copying a file, encoding a video, and performing an image manipulation.

The framework has several methods of detecting task completion, depending upon the method the application uses to signal task completion to the user. For example, the framework may wait for the application to show a completion message in the form of a pop-up window, or it may wait for a progress dialog to disappear and for control of the application to be returned to the user.

3 Workload Characteristics

This section provides data illustrating the battery life and performance characteristics of SYSmark 30.

3.1 Sensitivity Analysis

The series of tables below shows the sensitivity of SYSmark 30 performance scores to different system characteristics, including the amount of system memory (RAM), number of CPU cores, type of storage device, and display resolution. The study was conducted using a desktop system to allow better control of the system components being evaluated. The effect of component sensitivity on battery life is not included in this study.

Within each configuration only one system component (e.g. memory) is varied. All the other system components are held constant. To best illustrate the sensitivity,

one configuration is chosen as a baseline and the ratings for the other configurations are shown as the percentage difference relative to the baseline.

Sensitivity study system configuration information

- CPU: Intel Core i9-12900k, Turbo, HT, and e-cores disabled, except as noted
- RAM: 2x32gb DDR5 (64gb dual channel)
- Storage: Samsung 980 Pro 500gb
- GPU: Intel UHD 770
- Resolution: 1920x1080
- OS: Windows 11 x64 version 22621.521

For the tables below, the following components are varied as noted:

- System Memory:
    - DDR4 3000 1x32gb single channel
    - DDR4 3000 2x32gb dual channel
    - DDR5 4800 1x32gb single channel
    - DDR5 4800 2x32gb dual channel

- CPU - Cores adjusted in OS settings ○ 2c2t ○ 4c4t ○ 6c6t ○ 8c8t
- Storage ○ Seagate 500GB ST500LT012 @ 5400rpm ○ Western Digital 1TB WD1003FZEX @ 7200rpm
    - Intel 545s SSD SATA 3.0 256 GB ○ Samsung 980 Pro NVME 500GB
- Graphics ○ Intel UHD 770 ○ NVIDIA GTX 1650 ○ NVIDIA RTX 3080
- Resolution ○ 1366 x 768 @ 60Hz ○ 1920 x 1080 @ 60Hz ○ 2560 x 1600 @ 60Hz ○ 3840 x 2160 @ 60Hz

3.1.1 Sensitivity to System Memory

The total system memory is varied as noted in the charts below. The data are normalized to the baseline config in each chart.

3.1.1.1 Single channel vs dual channel

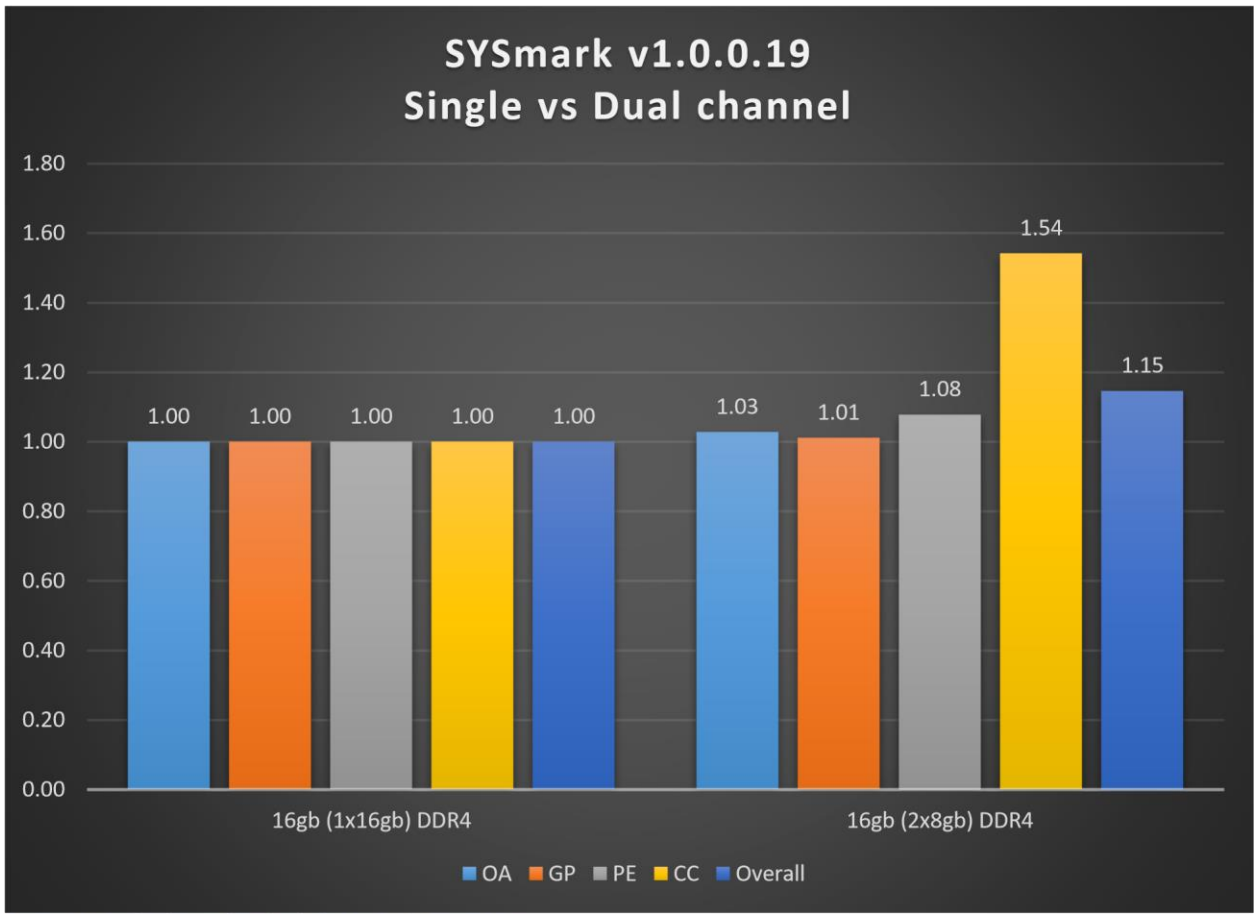

Figure 1 Single channel vs dual channe RAM sensitivity

3.1.1.2 Sensitivity to RAM capacity

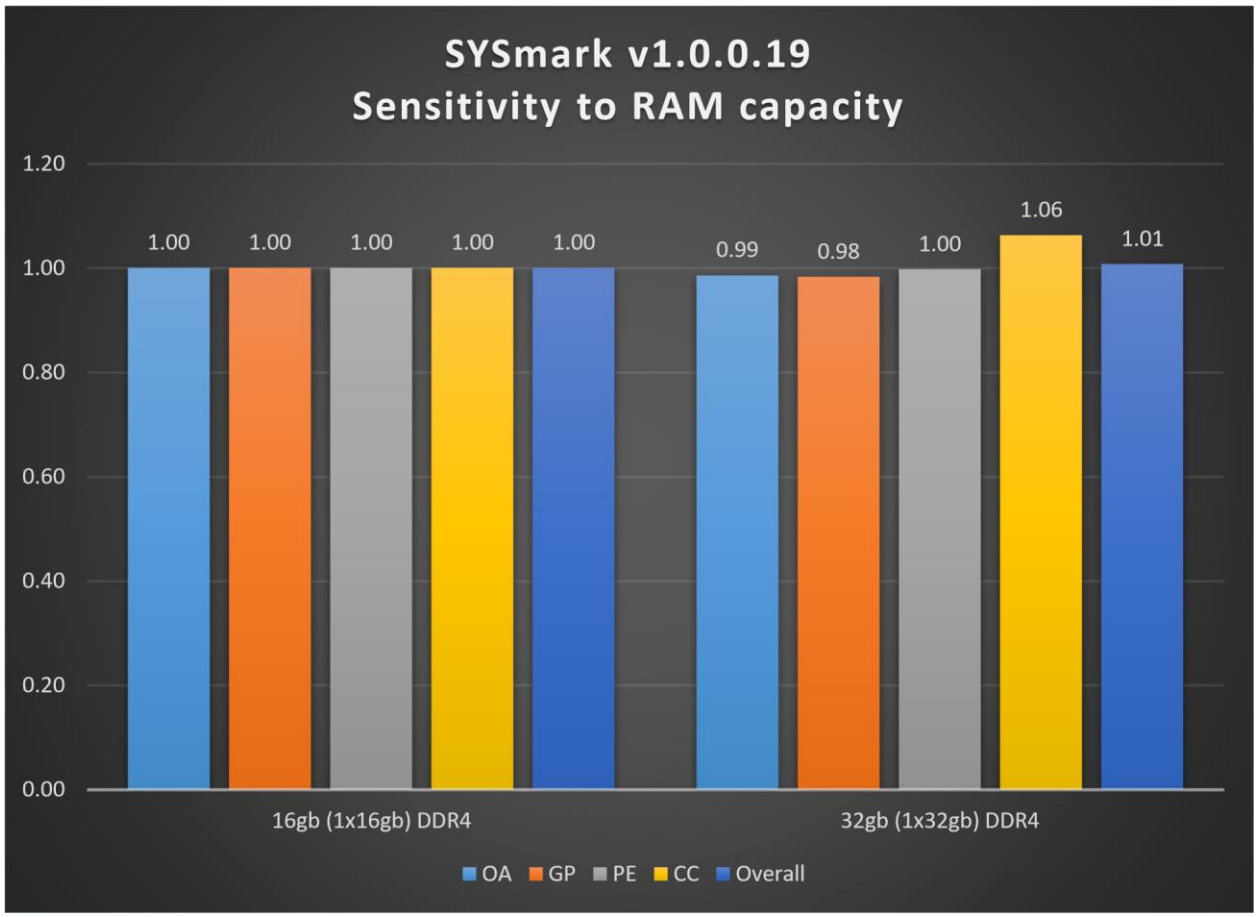

Figure 2 Sensitivity to RAM capacity

3.1.1.3 Sensitivity to RAM type (DDR4 vs DDR5)

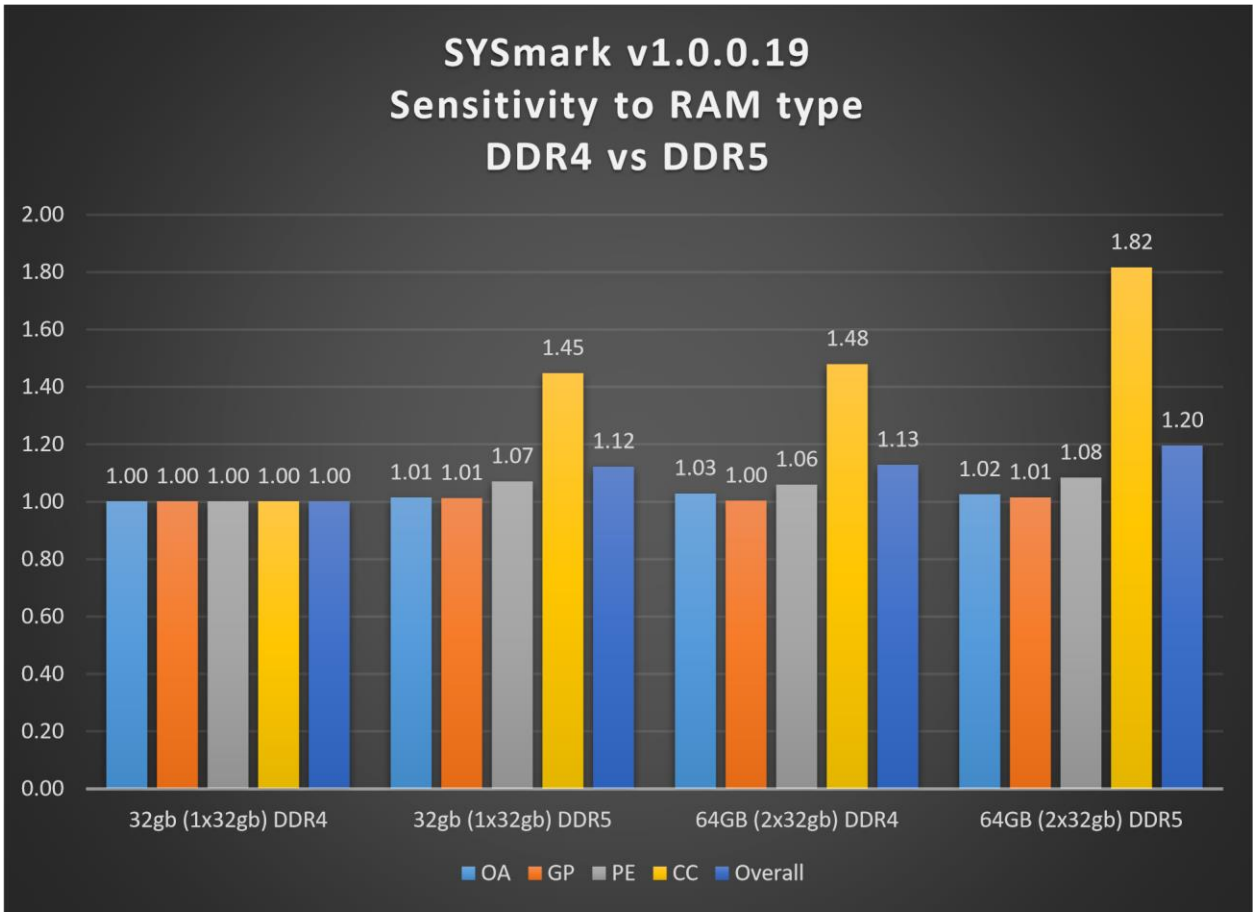

Figure 3 Sensitivity to RAM type, (DDR4 vs DDR5). This chart also includes a single channel vs dual channel comparison for DDR4 and DDR5 data.

3.1.2 Sensitivity to CPU Cores

Cores and threads available to the system were limited using Windows OS settings. Turbo, Hyper-Threading, and E-cores were disabled for this study.

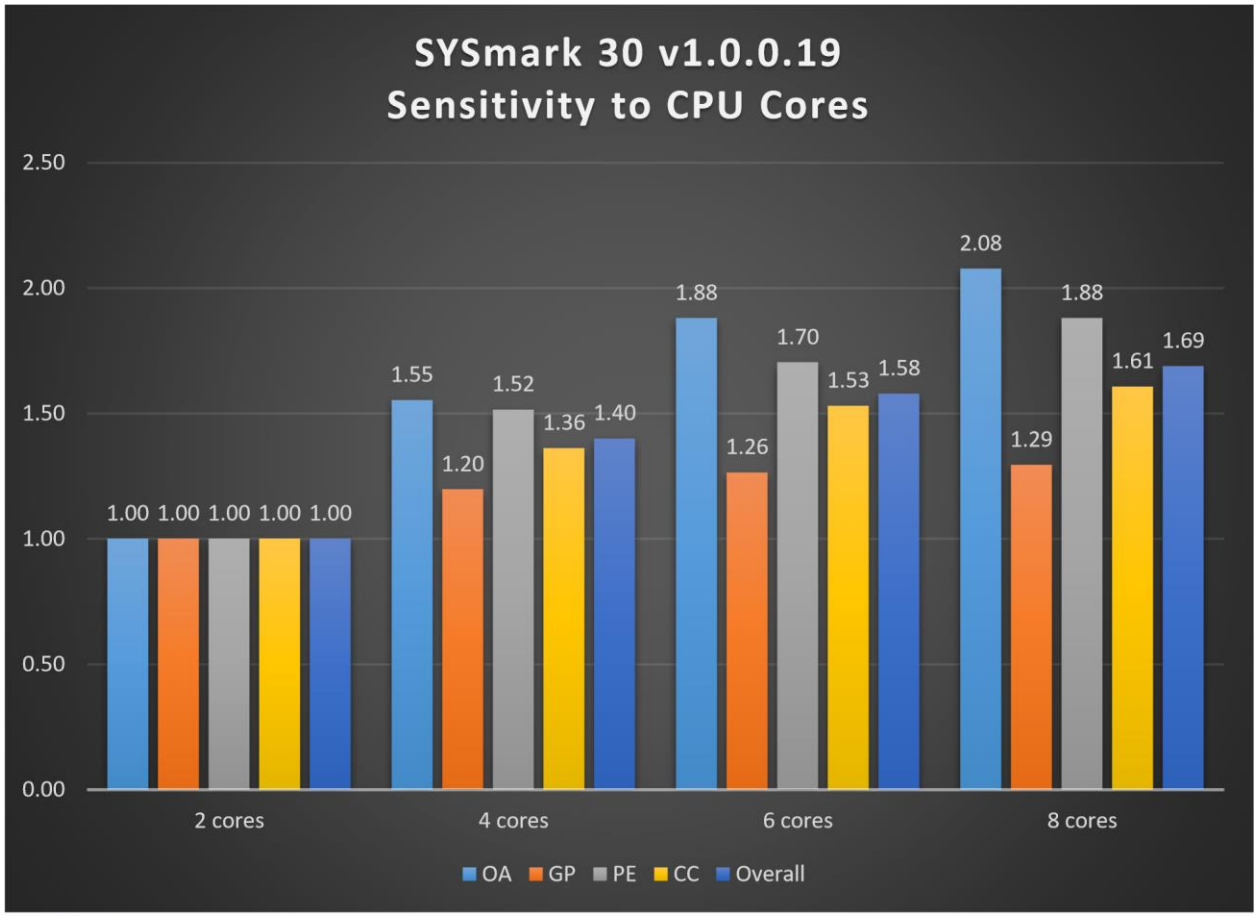

Figure 4 Sensitivity to CPU cores

3.1.3 Sensitivity to I/O Subsystem

The primary storage device is modified using a mix of HDD and SSD configurations. The results are normalized to the 2.5 inch, 5400 RPM HDD configuration.

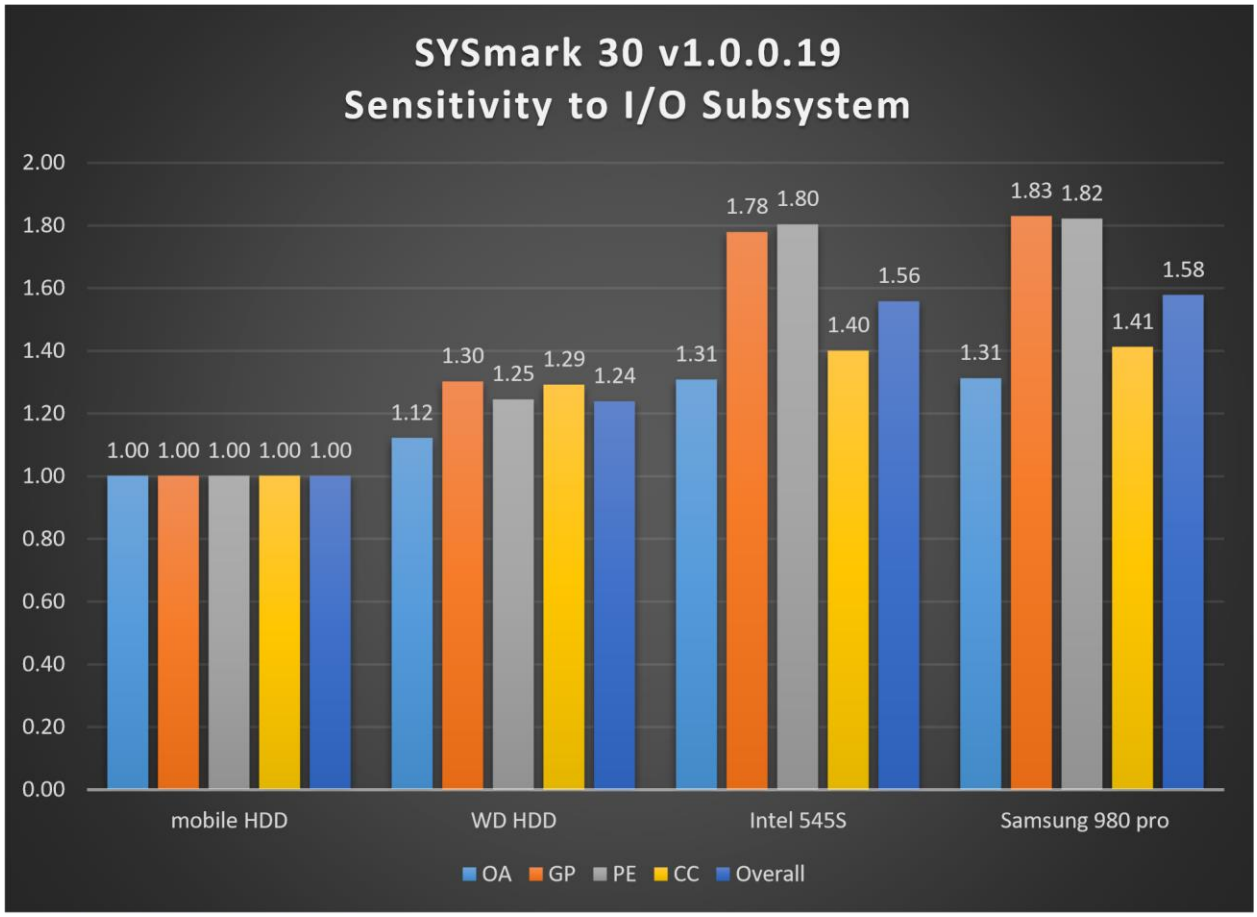

Figure 5 Sensitivity to I/O subssytem

3.1.4 Sensitivity to Graphics Card

The system graphics controller is changed from the Integrated GFX to various models of discrete graphics cards.

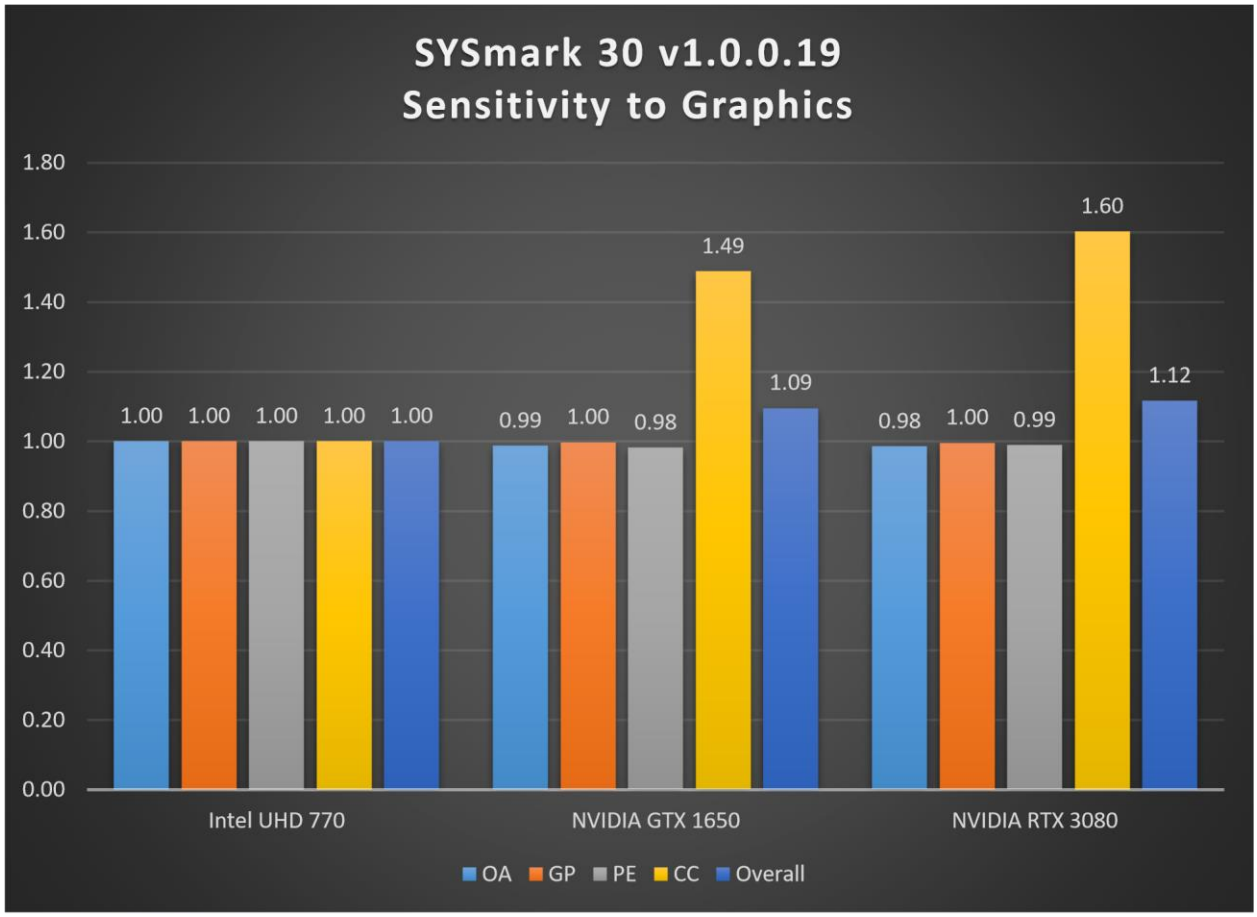

Figure 6 Sensitivity to GPU

3.1.5 Sensitivity to Display Resolution

The system display resolution is changed, from 1366 x 768 to 1920 x 1080 to 3060 x 1440 to 3840 x 2160.

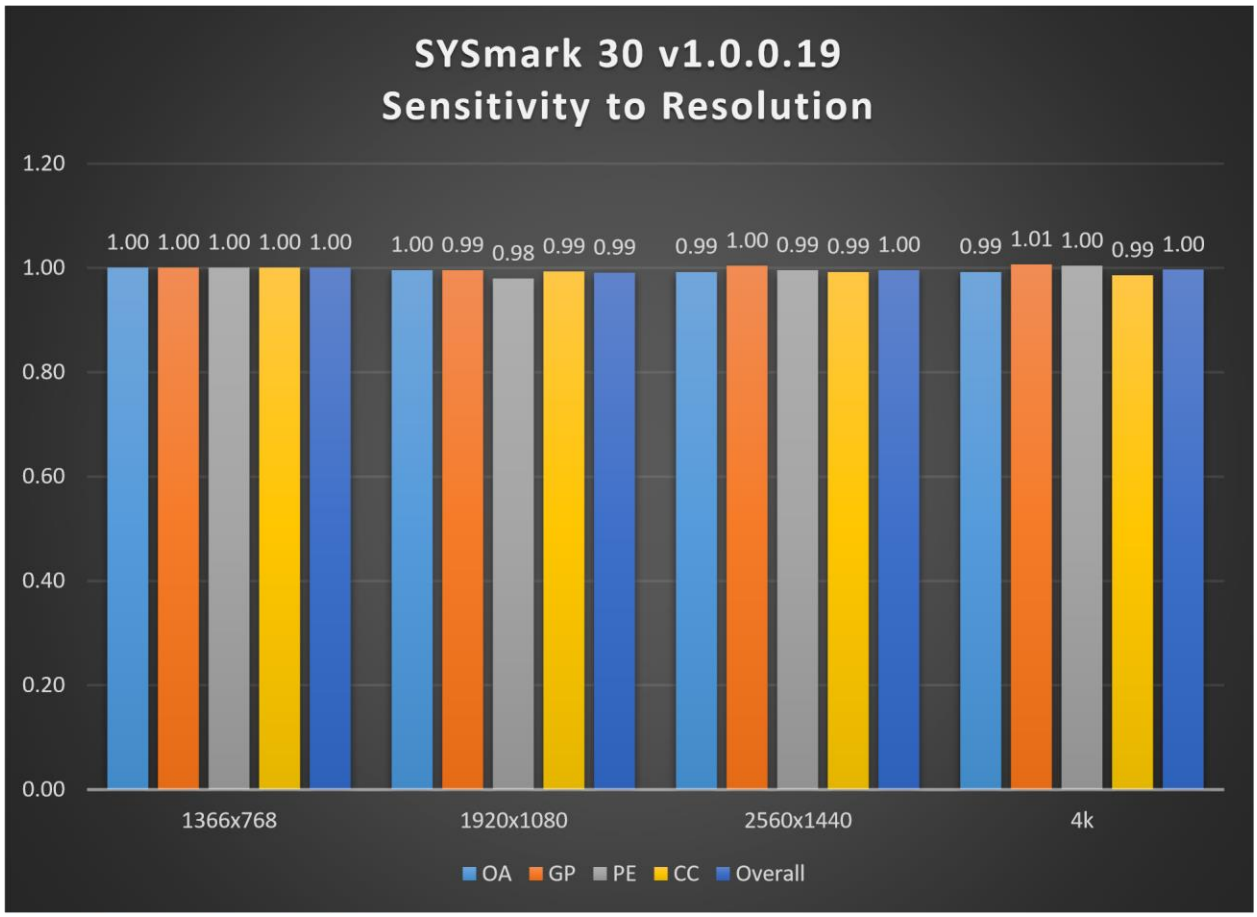

Figure 7 Sensitivity to screen resolution

3.4 Application contribution

The following charts shows the approximate contribution of each application to the SYSmark 30 Overall performance score on the calibration system.

Due to system implementation differences, this chart is accurate for the calibration system only. These contributions will vary with system configuration differences.

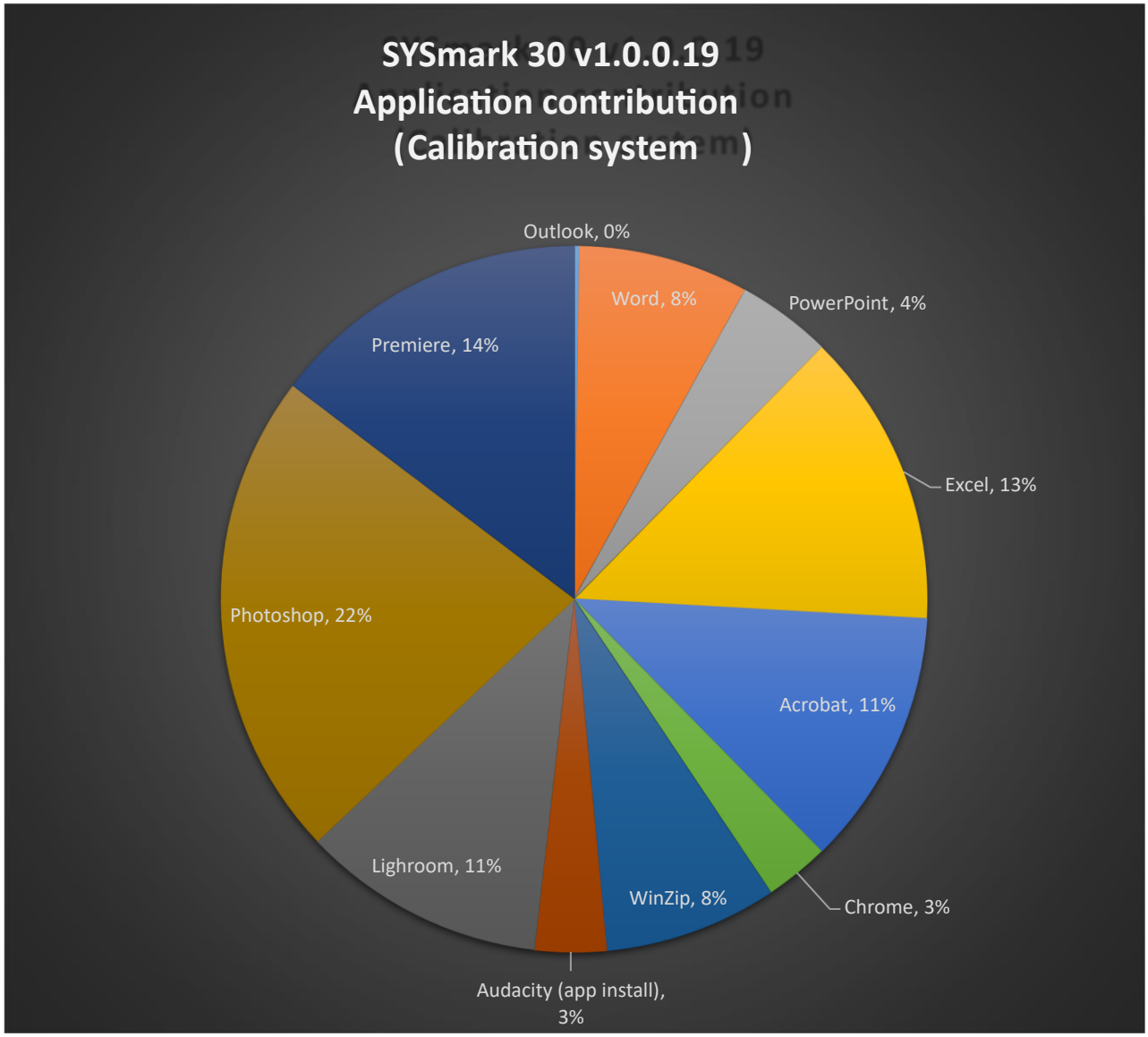

Figure 8 Application contribution to the overall SYSmark score

APPENDIX A: Minimum System Requirements

SYSmark 30 has the following minimum requirements:

- **CPU**:– CPU: 2015 or newer x86 processor (Intel 6th Generation Core or AMD 7000 series APU)
- **RAM:** 16 GB

- **HDD/SSD:** 30 GB of free space on the primary drive
- **Operating System:** Microsoft® Windows® 10 64-bit version 19H2 or higher. Microsoft Windows 11 64-bit version 22000.194 or higher, Windows 11 version 22621.521 or higher
- **Resolution:** 1280x800 or 1366x768, 2gb of VRAM
- **Graphics:** DirectX 12 compatible

APPENDIX B: Screenshots

This series of screenshots illustrate the SYSmark 30 user interface, the PDF results report, and benchmark applications executing various points in the workload.

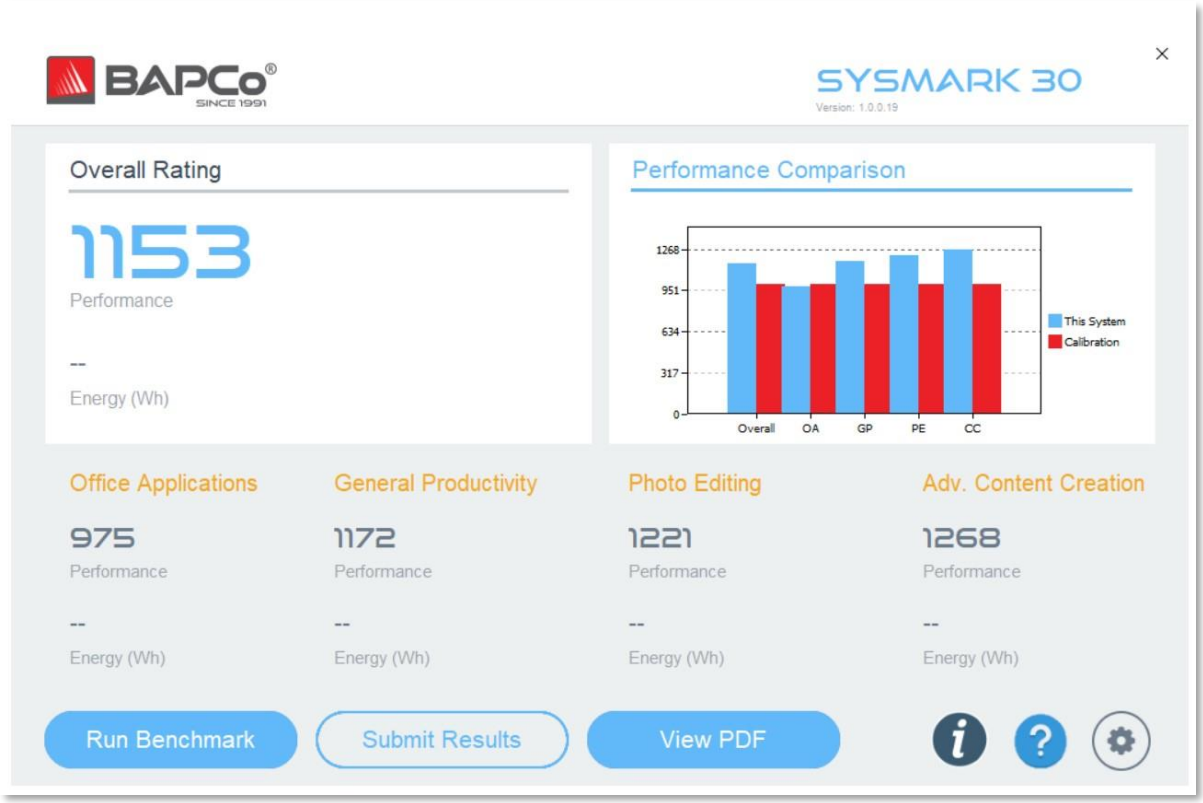

Figure 9: SYSmark 30 launch screen

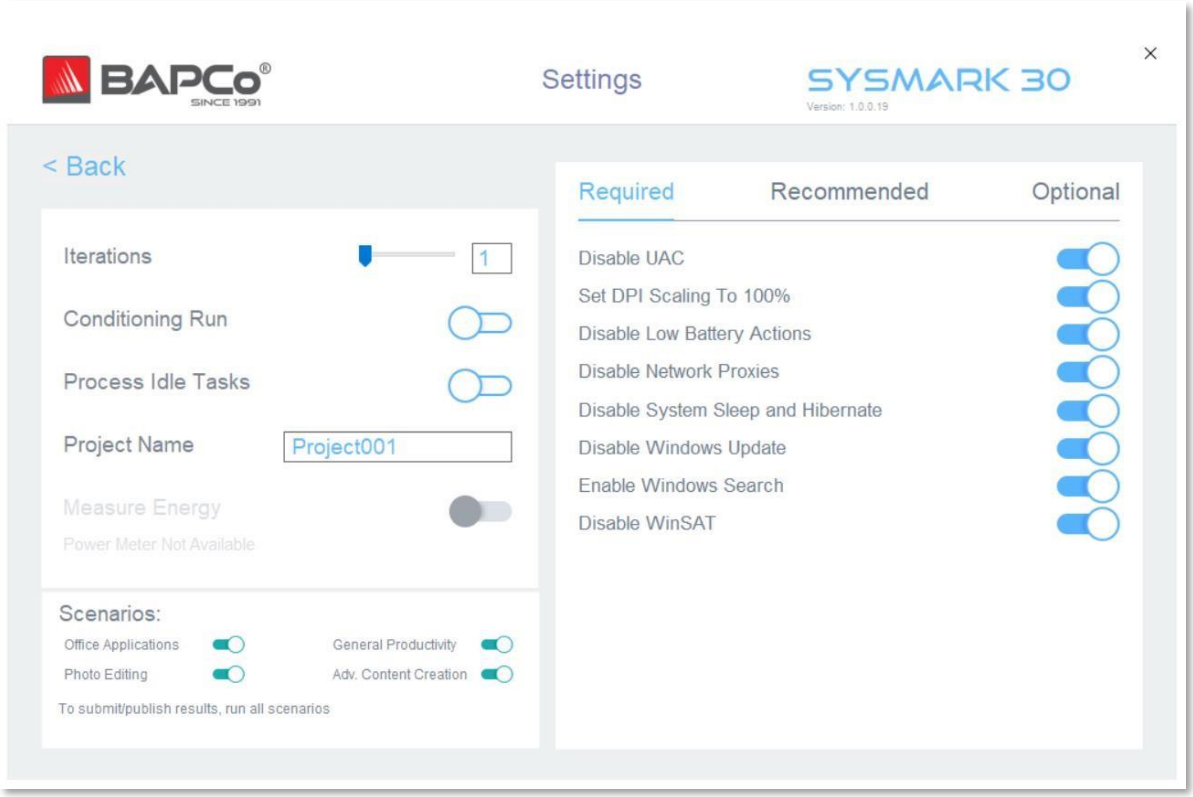

Figure 10: SYSmark 30 Config Tool settings

Figure 11: SYSmark 30 Heads Up Display

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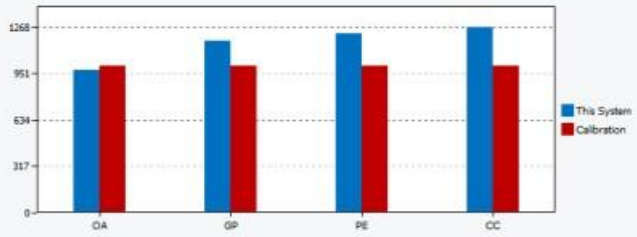
SYSMARK 30

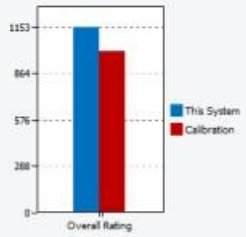
Test Summary

Project Name	Demo
Benchmark Version	1.0.0.19
Completion Date	2023-10-11 20:47:29
Iteration	1
System Conditioning	False
Process Idle Tasks	False
Valid Project	True: These results MAY be valid for submission and publication. See Benchmarking Rules in User Guide.

Performance Scores

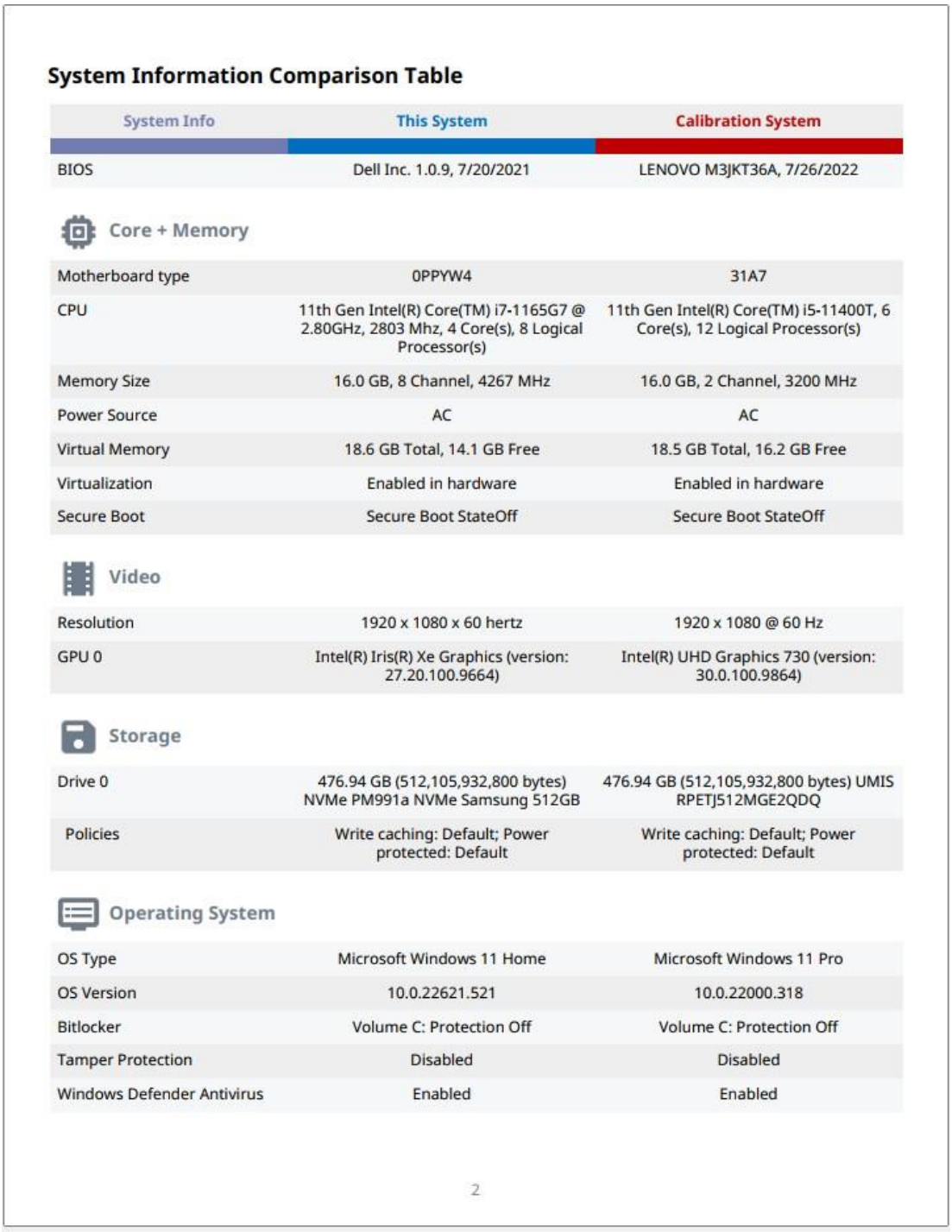
	Office Applications	General Productivity	Photo Editing	Adv. Content Creation	Overall Rating
Scenario Rating	975	1172	1221	1268	1153
Iteration 1	975	1172	1221	1268	
Calibration	1000	1000	1000	1000	1000





1

Figure 12: SYSmark 30 results PDF page 1

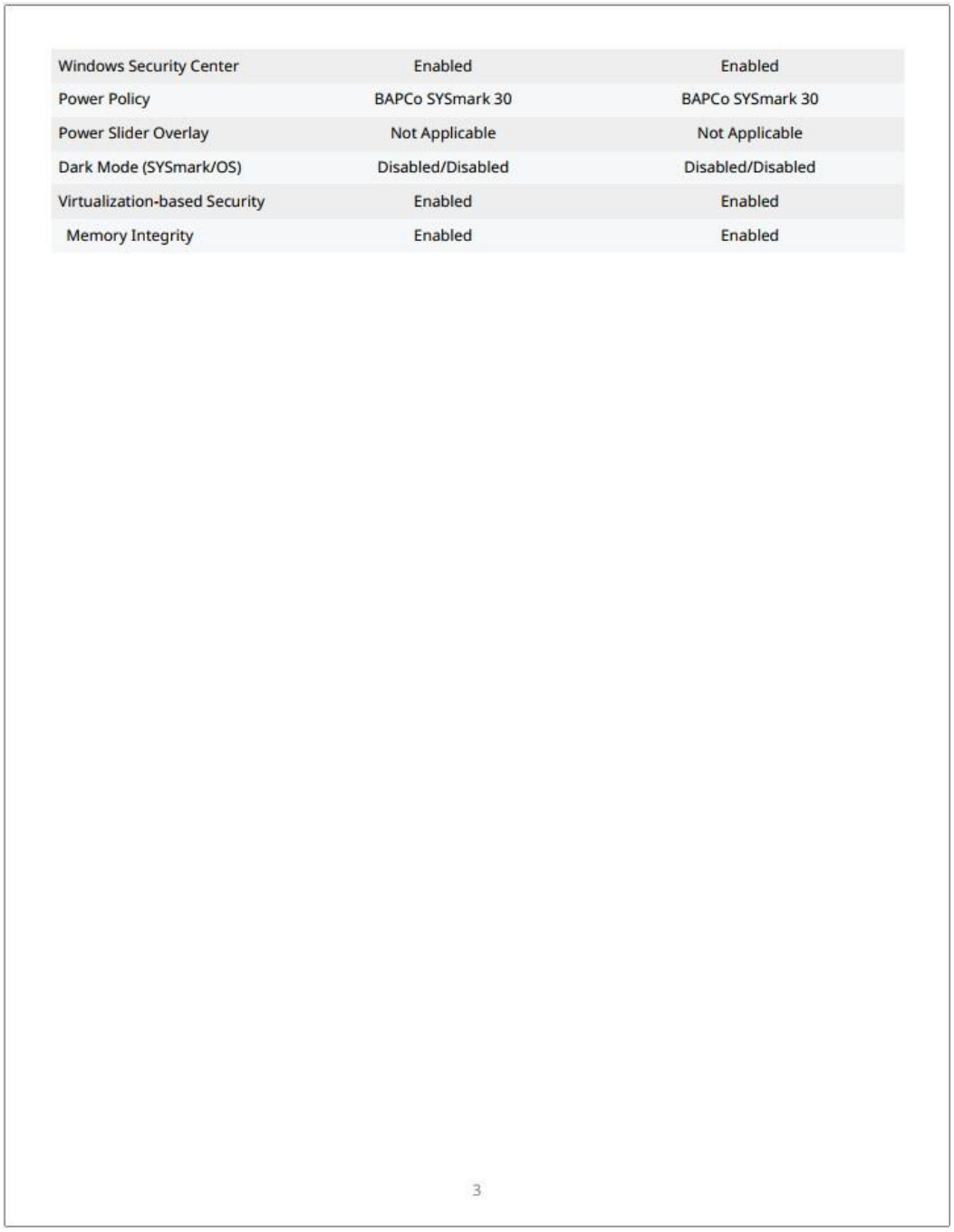


System Information Comparison Table

System Info	This System	Calibration System
BIOS	Dell Inc. 1.0.9, 7/20/2021	LENOVO M3JKT36A, 7/26/2022
Core + Memory		
Motherboard type	0PPYW4	31A7
CPU	11th Gen Intel(R) Core(TM) i7-1165G7 @ 2.80GHz, 2803 Mhz, 4 Core(s), 8 Logical Processor(s)	11th Gen Intel(R) Core(TM) i5-11400T, 6 Core(s), 12 Logical Processor(s)
Memory Size	16.0 GB, 8 Channel, 4267 MHz	16.0 GB, 2 Channel, 3200 MHz
Power Source	AC	AC
Virtual Memory	18.6 GB Total, 14.1 GB Free	18.5 GB Total, 16.2 GB Free
Virtualization	Enabled in hardware	Enabled in hardware
Secure Boot	Secure Boot StateOff	Secure Boot StateOff
Video		
Resolution	1920 x 1080 x 60 hertz	1920 x 1080 @ 60 Hz
GPU 0	Intel(R) Iris(R) Xe Graphics (version: 27.20.100.9664)	Intel(R) UHD Graphics 730 (version: 30.0.100.9864)
Storage		
Drive 0	476.94 GB (512,105,932,800 bytes) NVMe PM991a NVMe Samsung 512GB	476.94 GB (512,105,932,800 bytes) UMIS RPETJ512MGE2QDQ
Policies	Write caching: Default; Power protected: Default	Write caching: Default; Power protected: Default
Operating System		
OS Type	Microsoft Windows 11 Home	Microsoft Windows 11 Pro
OS Version	10.0.22621.521	10.0.22000.318
Bitlocker	Volume C: Protection Off	Volume C: Protection Off
Tamper Protection	Disabled	Disabled
Windows Defender Antivirus	Enabled	Enabled

2

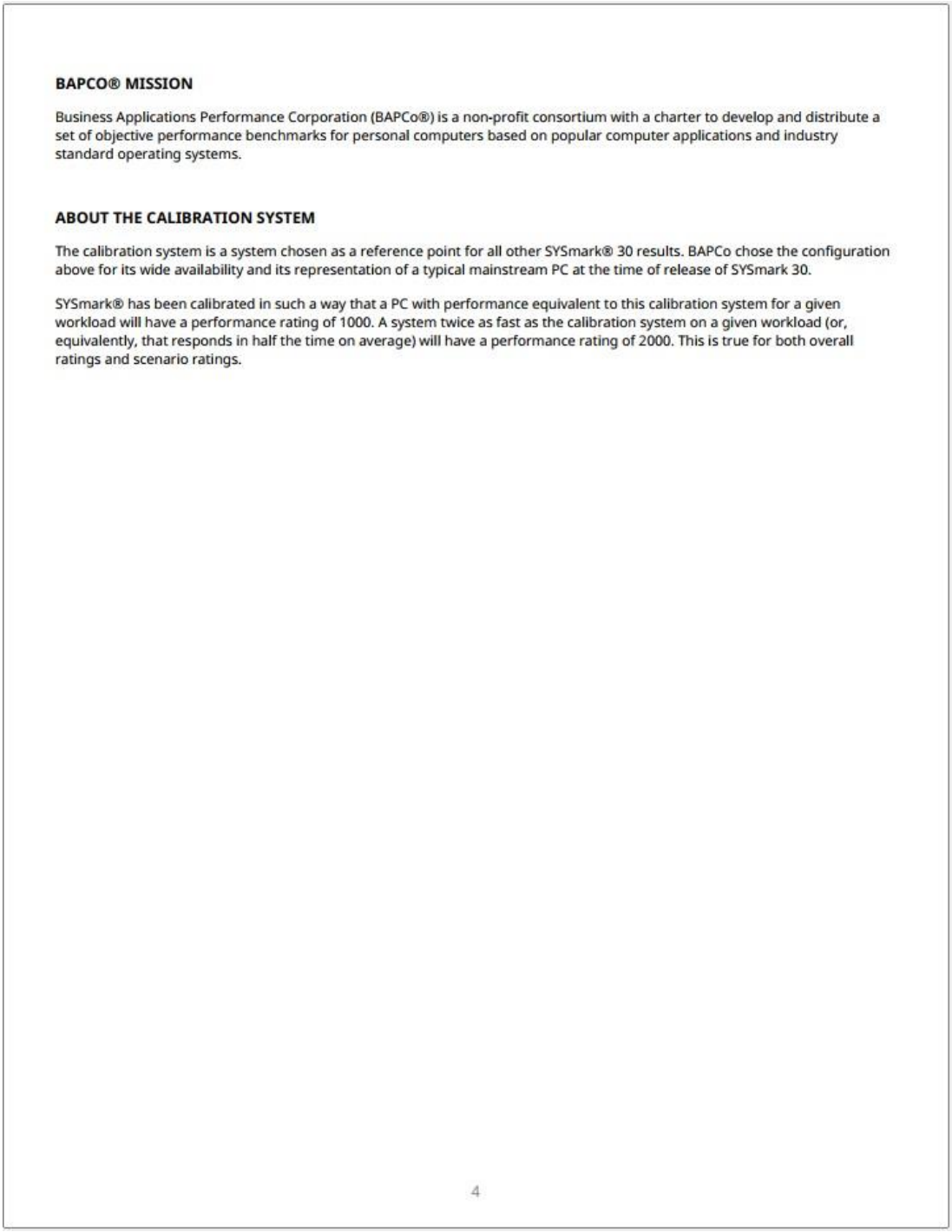
Figure 13: SYSmark 30 results PDF page 2



Windows Security Center	Enabled	Enabled
Power Policy	BAPCo SYSmark 30	BAPCo SYSmark 30
Power Slider Overlay	Not Applicable	Not Applicable
Dark Mode (SYSmark/OS)	Disabled/Disabled	Disabled/Disabled
Virtualization-based Security	Enabled	Enabled
Memory Integrity	Enabled	Enabled

3

Figure 14: SYSmark 30 results PDF page 3



BAPCO® MISSION

Business Applications Performance Corporation (BAPCo®) is a non-profit consortium with a charter to develop and distribute a set of objective performance benchmarks for personal computers based on popular computer applications and industry standard operating systems.

ABOUT THE CALIBRATION SYSTEM

The calibration system is a system chosen as a reference point for all other SYSmark® 30 results. BAPCo chose the configuration above for its wide availability and its representation of a typical mainstream PC at the time of release of SYSmark 30.

SYSmark® has been calibrated in such a way that a PC with performance equivalent to this calibration system for a given workload will have a performance rating of 1000. A system twice as fast as the calibration system on a given workload (or, equivalently, that responds in half the time on average) will have a performance rating of 2000. This is true for both overall ratings and scenario ratings.

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Figure 15: SYSmark 30 results PDF page 4

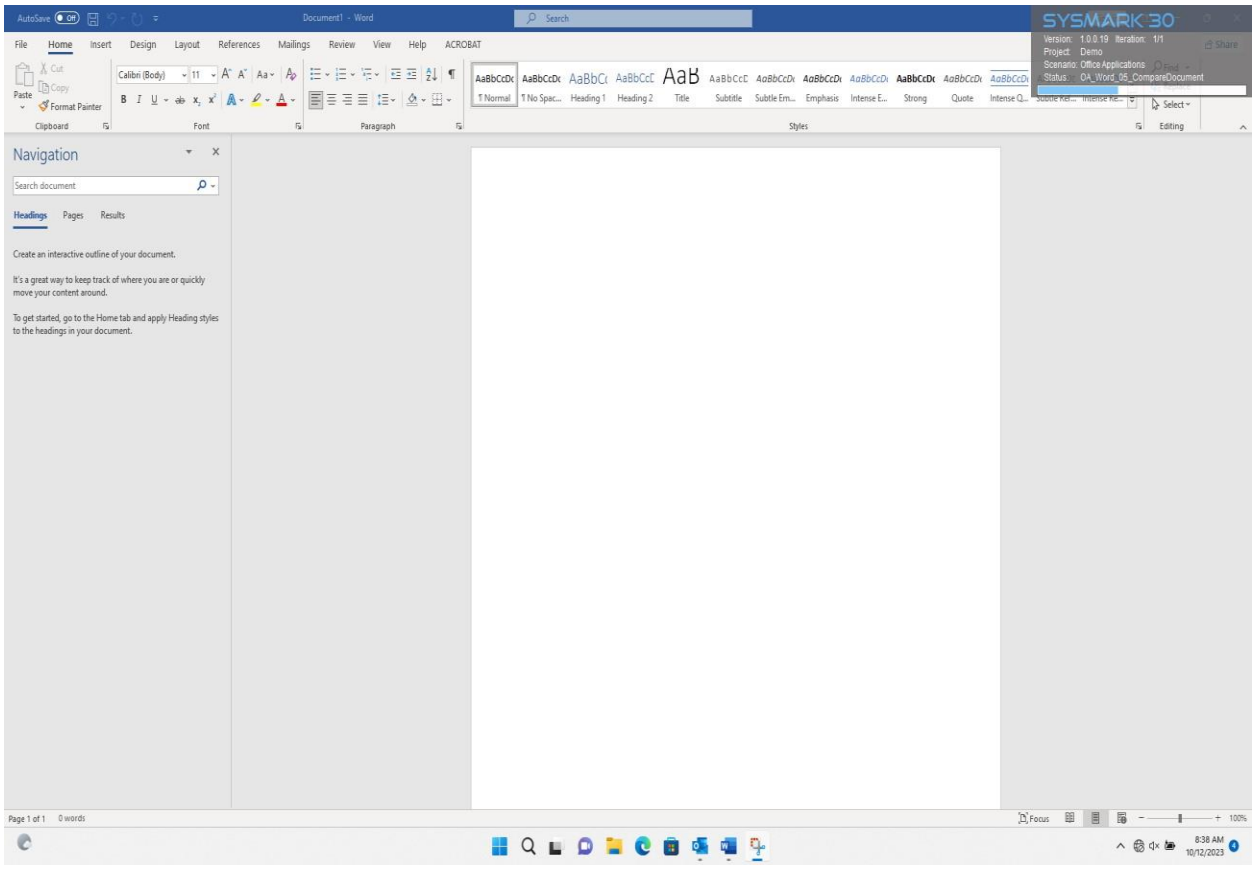

Figure 16: MS Word launches document

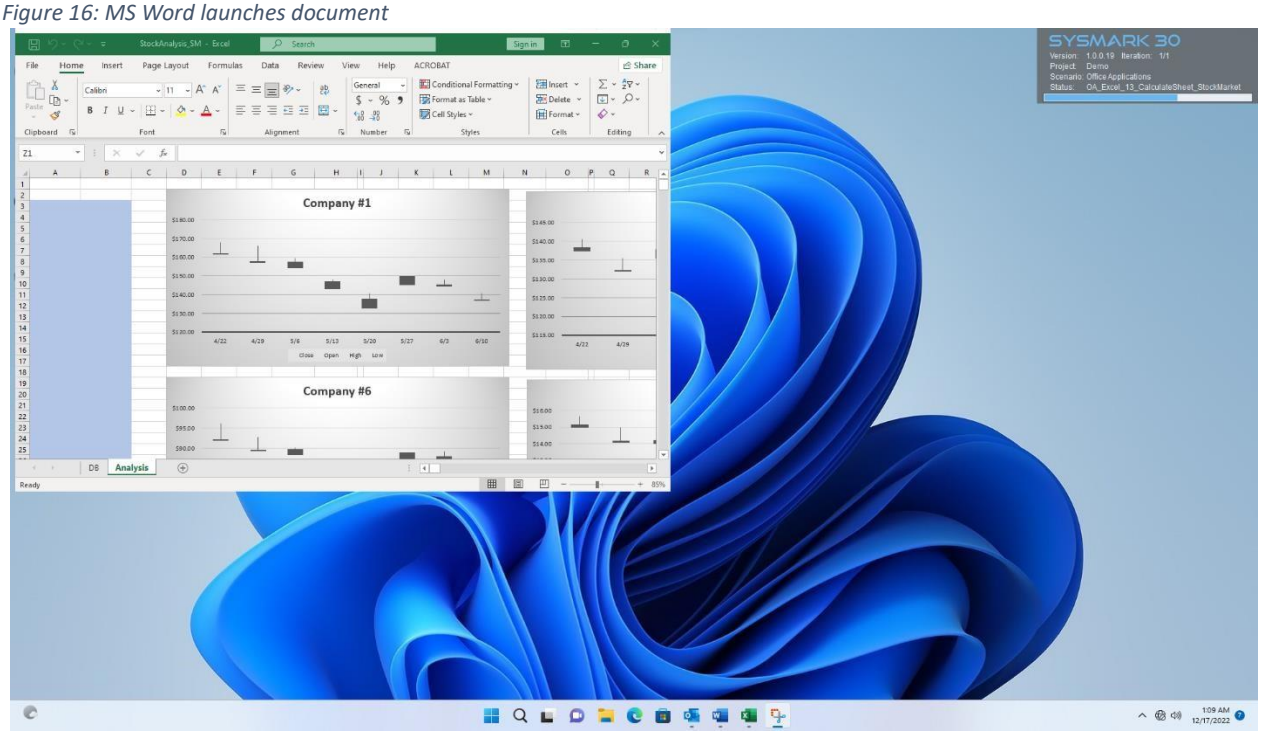

Figure 17Excel financial calculation

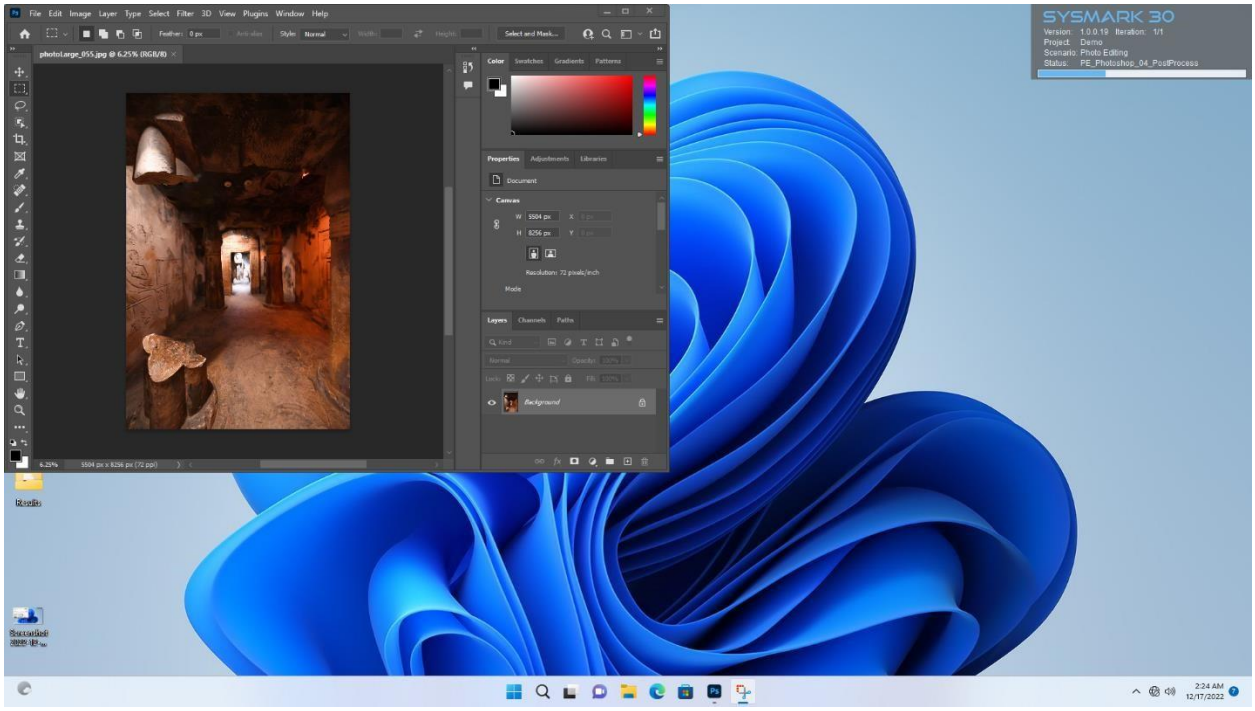

Figure 18: Adobe Photoshop in SYSmark 30 Photo editing scenario

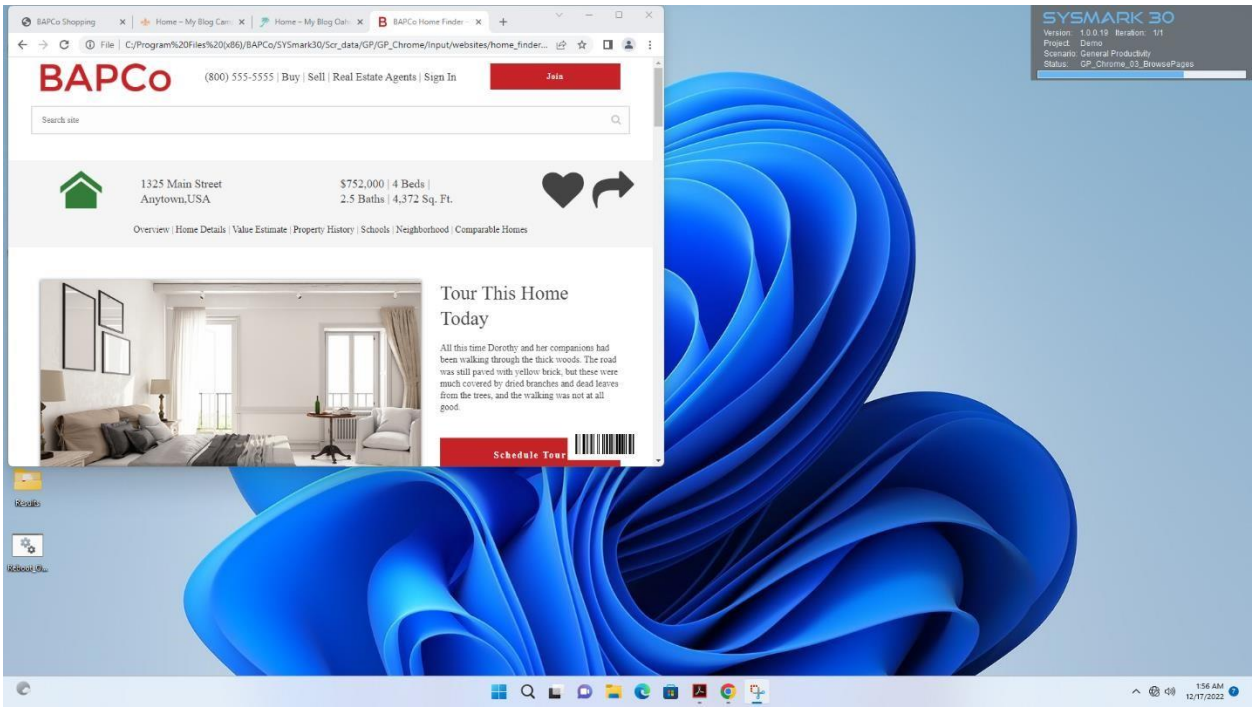

Figure 19: Browsing web page in Google Chrome