Using an AWR Report to Size an Azure VM

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Scope

This document uses the Automatic Workload Repository, (AWR) to gather workload data for an Oracle database and provide estimates for sizing once specific fields from the report are populated to an Excel spreadsheet.
Disclaimer: *Each version and database type of the AWR report can display data differently. The fields are the same, but the data may be in a different order, have a different header, etc. This document is to offer guidance in filling it out. If unsure, escalate for assistance, as an incorrect number could impact sizing estimates immensely.*

Assumptions

- AWR Report with 7-day or longer workload report
- The AWR Analysis sizing template
- Basic understanding of AWR data and Excel
- The Oracle database is either a single Oracle instance or RAC
- The Oracle database isn't on an engineered system such as Exadata

Process

Although the AWR report can provide essential data about workload, database usage and optimization for a cloud project, specific calculations can offer us invaluable data on what is required for an Azure IaaS VM to run the Oracle database in the cloud. The following will explain step by step what values to gather from the report and where to place them in the spreadsheet.
The Spreadsheet is broken down into two worksheets, the AWR and the Calculations worksheet. There are multiple lines to take RAC and multiple instances into consideration.

The AWR Worksheet

The first three columns:

DB Name: the unique name given to the database.

Database		
Id	Name	RAC
1633071752	GBACSPRP	YES

Instance Name: Is the same as individual database node names in RAC or often the same as the DB Name for non-RAC databases.

Host Name: The name of the host. For RAC, each node will have a unique name.

Instance	Host
gbacsprs1	gbslo1exdb01.dunnhumby.c

Elapsed Time and DB Time: These two sections are commonly next to each other throughout the report.

Report Total (minutes)	
DB time	Elapsed time
14,628.65	10,040.28

DB CPUs: This can be a confusing metric, as CPU data is in numerous fields, but the value we're searching for is referred to as "DB CPU(s)". Enter it for each instance involved in the estimate.

Foreground Wait Classes

I#	User I/O(s)	Sys I/O(s)	Other(s)	Applic (s)	Commit (s)	Network (s)	Concurcy (s)	Config (s)	Cluster (s)	DB CPU (s)	DB time
1	3,810.80	18,629.87	4,703.05	48,118.02	922.14	2,417.59	482.03	1.76	1,772.12	189,371.91	308,469.93
2	2,530.80	115.61	2,353.61	58,401.86	1,003.08	3,905.13	496.52	2.11	1,665.19	209,455.96	283,219.56
3	3,774.36	1,560.68	3,795.82	50,500.30	1,011.93	2,760.93	388.57	3.23	1,339.03	217,165.35	286,029.28
Sum	10,115.96	20,306.16	10,852.48	157,020.18	2,937.16	9,083.65	1,367.12	7.10	4,776.34	615,993.22	877,718.77
Avg	3,371.99	6,768.72	3,617.49	52,340.06	979.05	3,027.88	455.71	2.37	1,592.11	205,331.07	292,572.92
Std	728.72	10,297.44	1,184.83	5,383.11	49.49	778.87	58.59	0.77	225.60	14,348.51	13,838.71

CPUs/Cores: Hyper-threading makes it important to have both these numbers. We commonly calculate off of the Cores value and ensure that you update the CPU calculation for it in the spreadsheet if you do note that there is hyperthreading involved. For the example below, a 3-node RAC has 320 hyperthreaded CPUs, with 160 CPU cores total for each.

I#	Num CPUs	CPU Cores
1	320	160
2	320	160
3	320	160

Memory(GB): Memory is captured in the same line as CPU information, but it is calculated differently than we need in our spreadsheet. Remember to convert from MB to GB as part the steps when you enter the info.

Memory (M)
6,191,158.41

/ 1024= Correct Value for Spreadsheet

%Busy CPU: This value is clearly stated in the report and is used to identify CPU saturation. A CPU is either on or off, but to know if enough CPU is available is part of our estimates. This is another value that can be confusing to gather. Go to the OS Statistics and for each instance CPU totals, look for %Busy.

% Busy
25.84

SGA(MB): This can be under different tables, depending on the version. It can be a good idea to do a search for "SGA". SGA Target demonstrates the beginning and end values for an adjusting vale. If you use this section, take the highest of the two values, (peak). If no value is shown for an ending value, it means no adjustment was made from the beginning value.

Sga Target	
Begin	End
32,768	

PGA(MB): Is the Process Global Area and this is a specialized area of memory allocated for sorting, hashing and other important processing. Heavier sorting is performed in Oracle due to lacking clustered indexes in the Oracle design. The memory allocated may not meet the needs of the database, which is a resiliency vs. sizing issue. Like SGA, the PGA Target will display a beginning and ending value for some AWR Reports. Take the larger of the two values displayed.

PGA Target	
Begin	End
32,768	

Read Throughput(MB/s) and Write Throughput(MB/s): This is a value that can be displayed in multiple ways and sections in the AWR report depending on the version and type of Oracle product. Search the report, (find on page if in a browser) for "IO Statistics". For the example below, a RAC database with 3 nodes, displays the Read throughput and write throughput for each instance:

IOStat by File Type (per Second)

- Total Reads includes all Filetypes: Data File, Temp File, Archive Log, Backups, Control File, Data Pump Dump File, Flashback Log, Log File, Other, etc
- Total Writes includes all Filetypes: Data File, Temp File, Log File, Archive Log, Backup, Control File, Data Pump Dump File, Flashback Log, Log File, Other, etc

	Reads MB/sec			Writes MB/sec				Reads requests/sec			Writes requests/sec			
I#	Total	Data File	Temp File	Total	Data File	Temp File	Log File	Total	Data File	Temp File	Total	Data File	Temp File	Log File
1	46.94	44.57	0.01	1.51	0.02	0.01	0.01	139.59	45.70	0.26	10.37	1.33	0.17	5.53
2	34.42	34.30	0.01	0.08	0.02	0.01	0.01	41.86	36.75	0.22	8.96	1.26	0.18	5.92
3	60.35	57.89	0.01	0.09	0.02	0.01	0.02	160.81	60.62	0.32	9.85	1.41	0.24	6.50
Sum	141.71	136.76	0.03	1.67	0.05	0.03	0.04	342.25	143.08	0.80	29.18	3.99	0.59	17.95
Avg	47.24	45.59	0.01	0.56	0.02	0.01	0.01	114.08	47.69	0.27	9.73	1.33	0.20	5.98

Read IOPs/Write IOPs: Like throughput, this section can be displayed in different parts of the AWR report, but often is in the Load Profile towards the top of the report or in the IO Statistics in the mid-section of others.

System Statistics - Per Second

I#	Logical Reads/s	Physical Reads/s	Physical Writes/s	Redo Size (k)/s	Block Changes/s	User Calls/s	Execs/s	Parses/s	Logons/s	Txns/s
1	20,652.58	5,540.18	3.26	12.25	176.16	19.10	22.49	10.40	0.92	2.00
2	28,469.81	4,392.11	3.29	12.03	222.90	11.57	33.02	9.98	0.98	2.26
3	33,854.74	7,411.34	3.66	13.47	251.38	13.87	27.95	11.56	0.97	2.51
Sum	82,977.14	17,343.63	10.20	37.75	650.44	44.54	83.46	31.94	2.87	6.76
Avg	27,659.05	5,781.21	3.40	12.58	216.81	14.85	27.82	10.65	0.96	2.25
Std	6,638.31	1,523.98	0.22	0.77	37.97	3.86	5.27	0.82	0.03	0.25

Calculating Factors for Worksheets

Once you've filled in this information, note that there is a gray box below the area to enter in all sections for instances:

Name of "fudge factor" adjustable	Default value	Setting
Est'd Peak CPU factor	2.00	2.00
Est'd Peak RAM factor	2.00	2.00
Est'd Peak I/O factor	2.00	2.00
vCPU HT multiplier	2	2
%Busy CPU-thrashing threshold	0.75	0.75
%Busy CPU-thrashing multiplier	1.25	1.25

Please do not change the default values

These values are here to help calculate for the type of workload that you are brining over. For Exadata, an IO metric fudge factor would be high, (in the example, 6 times what is being experienced in the workload) to take increased IO into consideration from loss in offloading and other engineered features.

Decide what you want for each of the following and make changes based on the following:

Peak CPU Factor: 2.00 is standard, 4.00 is for a workload that might have a huge variance expectation once it goes to the cloud.

Est'd RAM Factor: Same for CPU, but for RAM estimate. Normal is 2.00, 4.00 would be normal for an Exadata where the SGA is commonly shrunk to promote offloading.

vCPU HT Factor: Commonly 2.00 and this should be the default going to IaaS Azure VMs

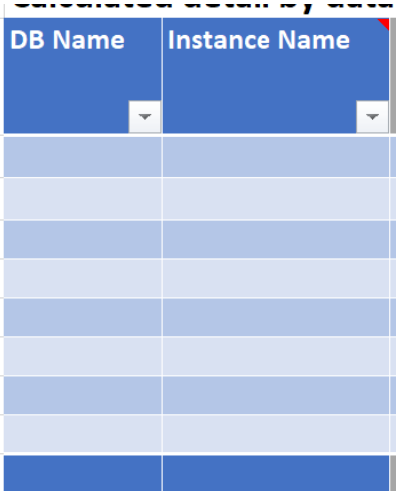
Busy CPU waits factor: 2.00 is the default

IO metrics(IOPS & MB/s) fudge factor: 2.00 is for transactional system, 4.00 is for DSS/OLAP, 6.00 is for Exadata.

Calculations Spreadsheet

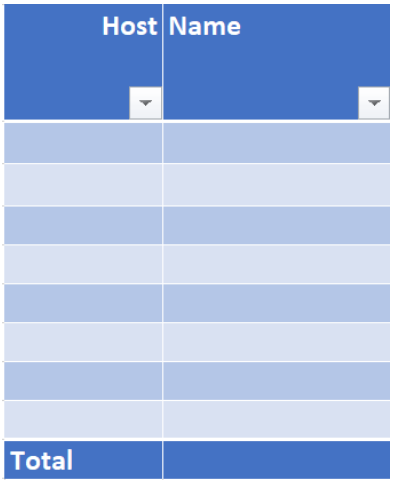
*Don't fill in any area OUTSIDE of the fields instructed, which have headers **filled with blue**. Columns are dependent on what is filled in on the AWR page to match what is in the appropriate fields on the Calculations page.*

1. Enter the DBName and Instance Name, duplicating the DB name if necessary, that corresponds to the instance name. Do not leave the first column blank if you filled in the second.



DB Name	Instance Name

2. Although the column looks like it extends for two, place the hostname for the servers for every instance in the first column of the next section.



Host Name	
Total	

3. Enter the db name, (database name, NOT instance name) in the third section, first column. If working on a RAC environment, the RAC database will be listed by the DB name one time, not for each node in this section. The Excel spreadsheet will calculate and total the resources required for a **single instance,** as this is our primary goal to achieve a fully supported environment on Azure by Oracle.

DB Name
Total

As you're entering the values into this second worksheet, calculations will appear. Once complete, you should have values for each database to size the workload into Azure. These values will then give you the information you need to choose one or more IaaS Azure VMs to size out a solution for the Oracle customer.

Example of Calculations for RAC to Single Instance

The following is an example of the output from a customer engagement. This involves two databases, both 2-node RAC environments. Notice that the DB Name column is listed twice for both, then the instance name is unique. No other information was filled in, as the values in the previous worksheet automatically populates and calculates what is needed.

Calculated detail by database instance

DB Name	Instance Name	%DB Time of Elapsed Time	%DB CPU of server capacity	Total ORA (GB)	Total IOPS	Total Throughput (MB/s)	Est'd Azure vCPUs
ARPH2PPD	ARPH2PPD1	3059.755%	48.951%	310	1,296.50	125.69	61.20
ARPH2PPD	ARPH2PPD2	2915.155%	45.965%	310	1,433.08	127.69	58.30
ARPH2PRD	ARPH2PRD1	669.554%	8.185%	310	2,538.29	190.88	13.39
ARPH2PRD	ARPH2PRD2	679.164%	8.366%	310	3,021.84	276.57	13.58
		7323.628%	111.469%	1,240	8,289.71	720.83	146.47

In the second section, only the host name was populated to the first column for each of the nodes for the RAC instances. As there are two nodes each for the two databases, four entries are added and the values populate from the first worksheet.

Aggregated calculations by host

Host Name	%DB Ti
dbsls504	
dbsls505	
dbslp2030	
dbslp2031	

In the last section, I only listed the two, global database names. The data for each of the nodes for each of the databases is calculated and total resources are displayed for the environment to be moved to Azure IaaS VMs. With the factoring numbers taken into consideration, we have average workloads from the AWR and then peak workloads which are calculated from the workloads and the factoring numbers.

Aggregated calculations by database from AWR information

DB Name	%DB Time of Elapsed Time (aka Avg Active Sessions or "AAS")	Observed memory (GiB) consumed only by Oracle	Est'd Azure vRAM for server	Observed IOPS	Observed I/O throughput (MB/s)	Est'd Azure IOPS for peak load	Est'd Azure Throughput (MB/s) for peak load	Est'd Azure vCPUs for avg load	Est'd Azure vCPUs for peak load	DB Size
DB1PRD	1173.464%	70	88	2,197.21	219.85	6,591.63	659.56	15	19	1014.4
DB2PRD	629.277%	74	93	4,637.84	972.60	13,913.52	2,917.80	8	8	11132.5
WH1PRD	442.869%	24	30	16,271.70	1,795.15	48,815.10	5,385.45	6	6	1685.4
SC1PRD	234.098%	47	59	4,884.30	160.96	14,652.90	482.88	3	3	1836.4
Total	2479.71%	216	269	27,991.05	3,148.56	83,973.15	9,445.69	32	36	15668.7

For our examples:

DB1PRD will require:

- 15 vCPU for an average load and 19 vCPU for a max workload.
- A server with 88G of memory and 70G allocated to the database.
- Disk IOPS 6600 and 660MB/s throughput

The subsequent databases can be seen with their own values, each with different workloads and demands below DB1PRD-

- DB2PRD
- WH1PRD
- SC1PRD

There is a total that is displayed at the bottom, but this is only available if you need to know how many resources will be required towards the project. The values we have here is what we require to size out the Azure VM.

Possible Recommendations

This section will require knowledge of Azure infrastructure to make valid recommendations on VM compute and storage to choose the right combination to run the Oracle workload(s) assessed that were identified in the example above.
We will then fill out the recommendations for each database VM and the storage needs:

- vCPU and memory
- IO max limit and quantity of disks limit, (for attached disk, not a concern for our example, as we're using network attached Azure NetApp Files/ANF outside of the OS disk)
- Storage that can meet the IO limits based on the size, IO capability of the storage and the VM limit on IO.
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Possible recommendations:												
Calculated vCPU x vRAM:			Monthly pricing									
Databases	VM	vCPU x vRAM	Pay-as-you-go	1-year	3-year	Storage Type	Quantity	Storage Cost	OS Disk Type	OS Disk Cost	Backup Type	Backup Cost
DB1PRD	E16ds v5	16 vCPU * 128G	935.86	591.07	414.46	ANF			Premium P6	9.28		
DB2PRD WH1PRD	E32-16ds v5	16 vCPU * 256G	1,776.82	1,087.23	734.04	ANF	20TB	8043.32	Premium P6	9.28	AZSnap	1043.12
SC1PRD												
							Storage Cost	8043.32	OS Disk Cost	18.56	Backup Cost	1043.12
		Compute Cost	$2,712.68	$1,678.30	$1,148.50							
		Storage Cost	8043.32	8043.32	8043.32							
		OS Disk Cost	18.56	18.56	18.56							
		Backup Cost	1043.12	1043.12	1043.12							
		Total Monthly Azure Cost	$11,817.68	$10,783.30	$10,253.50							

We fill in the information about each database, the VM, the amount of resources, the pay as you go, the 1 and 3 year pricing. We then put in the storage type, quantity/size and cost, followed by any OS disk and backup type/cost. Notice that the calculations from the storage, OS disk and backup cost will total to the bottom to be added to the individual pricing for VM, which has discounting based on the PAYG 1Yr of 3Yr discounting to then give you a calculated total for the Total Monthly Cost.
There is also a separate sheet if you would like to paste an architecture diagram, too.