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AIOUG – SANGAM11

Did someone say the word  
'Capacity'?

Neeraj Bhatia  
IT Service/Infrastructure Capacity Planner

# Speaker Information

- 7 years of experience in Oracle Database Performance Optimization and IT Services/Infrastructure Capacity Planning.
- Certified Oracle DBA – OCP 9i, 10g, 11g, RAC Expert
- Other Certifications – ISO/20000 Certified Auditor, ITIL Practitioner V3, Base SAS
- Currently working with Barclays Bank PLC as a Service Capacity Analyst
- When time allows I blog at <http://neerajbhatia.wordpress.com/>

# What is Capacity Planning

**“Capacity Planning is the process of predicting when future load levels will saturate the system and determining the most cost-effective way of delaying system saturation as much as possible”**

**- by Daniel A. Menasce and Virgilio A.F. Almeida**

(Authors of Capacity Planning for Web Services: Metrics, Models & Methods)

Why Capacity Management ?

- You don't want Service Interruption
- You don't want Performance Degradation
- IT Infrastructure has limited Capacity



# Capacity Management Activities

**PAST**

## **Analysis**

Analysis of Historical Data

Tools:

- AWR/Statspack,
- OS utilities - sar, vmstat

**PRESENT**

## **Monitoring & Review**

Real-time Monitoring, Capacity Review

Tools:

- Enterprise Manager
- AWR/Statspack,
- OS utilities - sar, vmstat

**FUTURE**

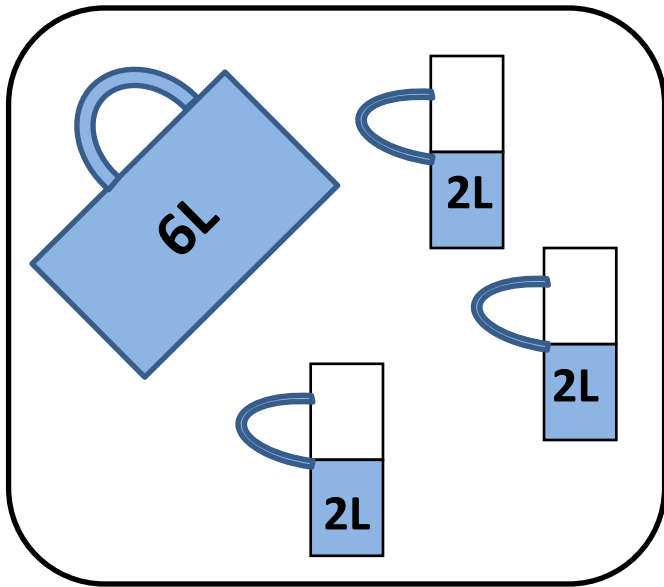
## **Modeling/Forecasting**

Future Capacity Forecasting

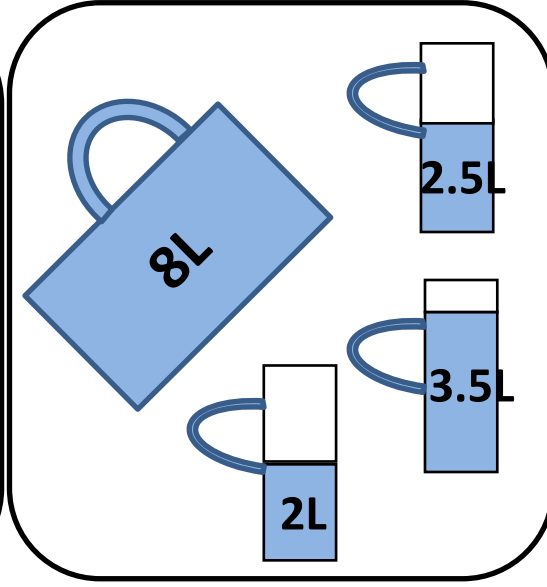
Tools:

- AWR/Statspack,
- OS utilities - sar, vmstat
- Regression Models, Queuing Theory Models etc.

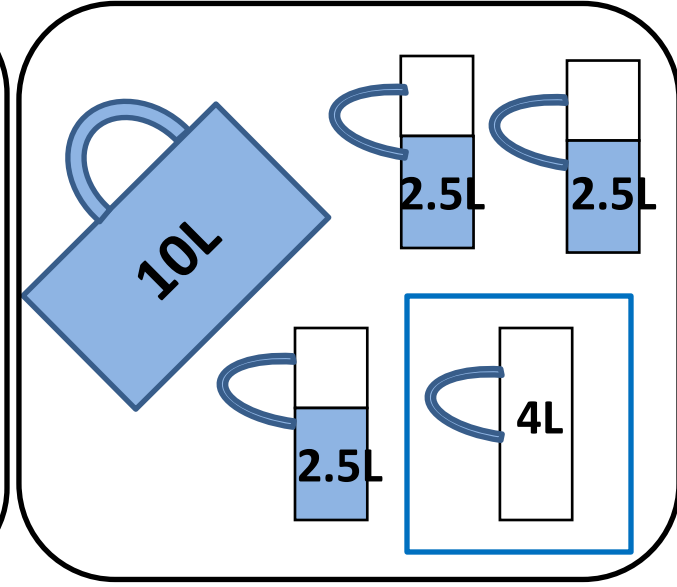
# Capacity Management Process Overview



*Capacity Provisioning*



*Capacity Review*



*Capacity Forecasting*

*The objective is to ensure that “cost-justified capacity” is always available and matched to the current and future agreed needs of the business in a “timely manner”.*

# The million \$ Question!

*Why my database is running sloww ... ?*



# Capacity Management & Performance Tuning

## □ Performance Tuning DBA

- ✓ Top Wait Events
- ✓ Sessions contributing to those wait events
- ✓ 10046 Trace Log files analysis
- ✓ Top session, Top SQLs etc

*in short ...*

***Reactive Performance Tuning***



## □ Performance Tuning DBA with Capacity Planning Skills

- ✓ Component Utilization Analysis
- ✓ Workload analysis – has workload increased significantly?
- ✓ Scope of Workload Management?
- ✓ Capacity Forecasting using predefined Models.

*in short ...*

***Proactive Performance Tuning***

# Capacity Planning: Methods

Technique	Cost (Time & Resources)	Precision	Suitable for ...
Rule of Thumb (ROT)	Low	Low	Quick, low-precision forecasting
Trend Analysis	Low	Moderate	Low-precision forecasting, Capacity Reporting etc
Modeling	Medium	Moderate to High	Response Time Analysis, What-if scenarios, Capacity Forecasting etc
Benchmarking	High	High	Proof of Concept (POC) Projects, What-if scenarios, Model configuration changes etc
Simulation	High	High	Response Time Analysis, What if scenarios, Model configuration changes, Capacity Forecasting etc

# Linear Regression Modeling

- Linear Regression is a method to investigate “linear” relationship between one or more independent variable and a dependent variable.

- The objective is to develop a model of the form

$$Y = M * X + C$$

Here Y = dependent variable, X = Independent variable, M = Slope, C= Intercept

- In-built Oracle functions to Regression Coefficient estimation etc

REGR\_SLOPE and REGR\_INTERCEPT, REGR\_R2, REGR\_COUNT etc

- Best suited for Study Questions:

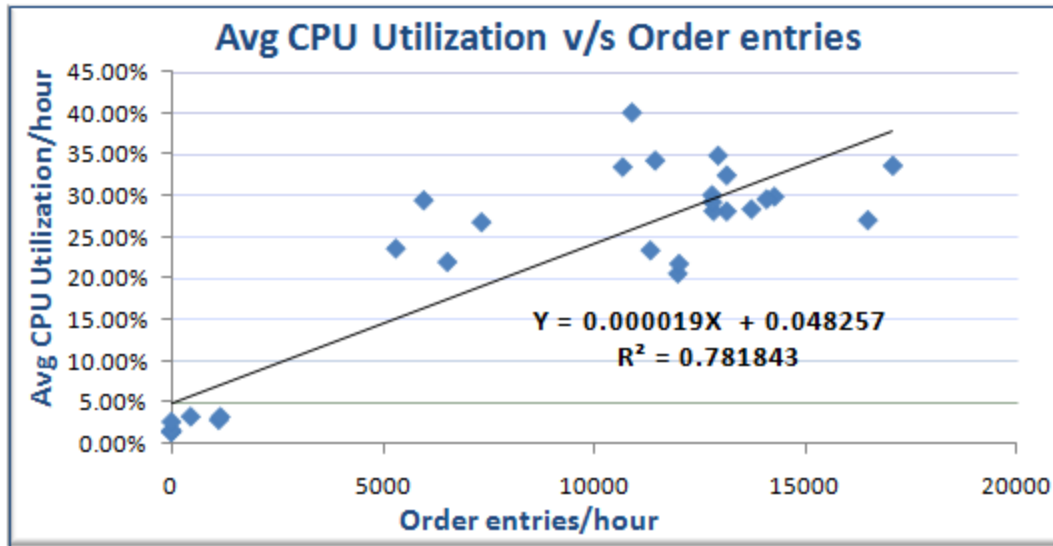
- How much load of some particular business activity database can support, before running “out of gas”?

- If the workload grows by x percentage every quarter, when we will need to add more capacity to the system?

For more details, please refer my paper “Linear Regression: An approach for forecasting”.

# Working Example: Regression Modeling

You are an Oracle DBA. The key business activity the database supports is Order management. Business wish to understand how many maximum order entries the database can support without any performance degradation.



$$\text{Avg CPU} = 0.000019 \times \text{Order Entries per Hr} + 0.048257$$

Max Order Entries per Hour with 75% CPU Utilization as upper limit

$$75\% = 0.000019 \times \text{Order Entries per Hr} + 0.048257$$

Max Order Entries per Hour ~ 36,180

# Queuing Theory Modeling

- Queuing theory is the mathematical study of Queues.
- It has the ability to estimate important performance properties of computer systems like *response time, waiting time, throughput* etc.



Arrival Rate (Txn/sec)

Transaction Queue



Number of Servers per Queue (M)

$$U = \frac{S\lambda}{M}$$

$$Q = \frac{S}{1-U^M}$$

$$R = Q + S$$

**U** => Utilization

**S** => Service Time, Sec/Txn

$\lambda$  => Arrival Rate, Txn/sec

**M** => Number of Servers

**Q** => Queue Time or Waiting Time

**R** => Response Time

# Working Example: Queuing Theory Modeling

Can the database (with 4 CPUs) support 40K orders per hour? What will be the response time impact and how much additional processing capacity would be required to achieve the same response time?

You have collected a sample and found:

Arrival Rate = 12,000 Orders/Hr with Average CPU Utilization of 36%

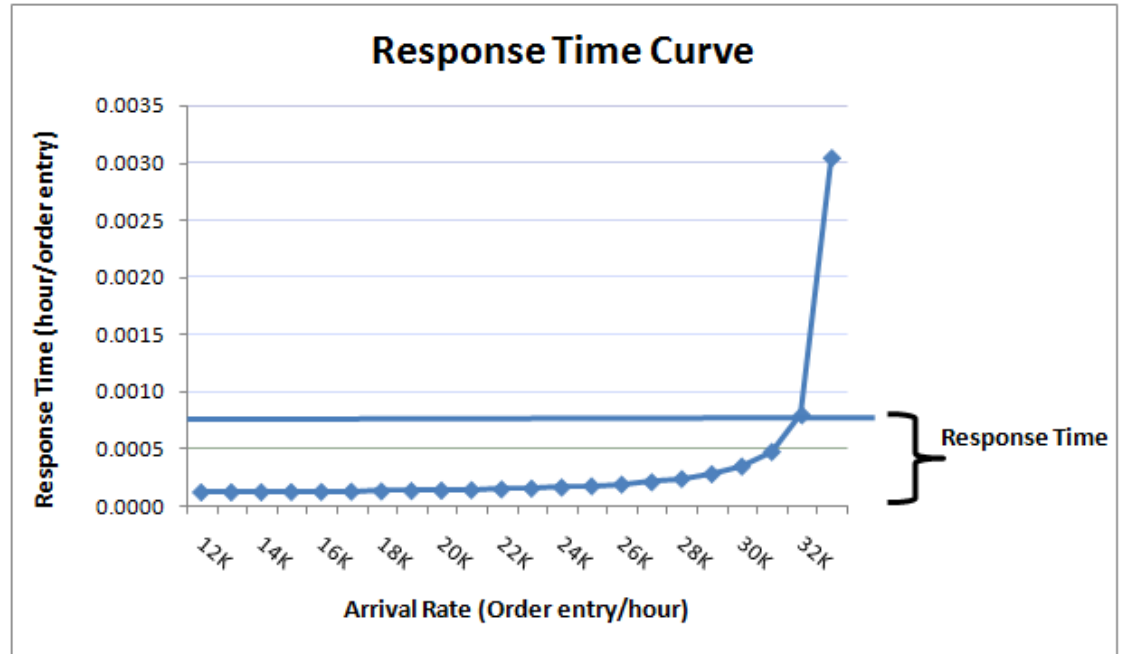
Service Time            0.00012000  
Response Time         0.00012205

➤ **At 40,000 Orders/hr**

**Utilization**            **120.00%**  
Response Time         -0.00011177

➤ **If we add 4 additional CPUs**

**Utilization**            **60.00%**  
Response Time         0.00012205



# Further Steps ...

- Capacity Planning is a very interesting field, Believe me!
- There is much more into this, my presentation is just a start.
- Read, explore and learn ...
- Additional Resources:
  - My blog - <http://neerajbhatia.wordpress.com/>
  - Book – “Forecasting Oracle Performance” by Craig Shallahamer.

You can reach me at [neeraj.dba@gmail.com](mailto:neeraj.dba@gmail.com)

**Would be happy to hear your experiences, success stories.**



