

Guerrilla Capacity Planning Exercises

Instructor: Dr. Neil J. Gunther

Copyright © 2017 Performance Dynamics Educational Services. All Rights Reserved.

Last revised : **Sunday, March 26, 2017**

Formulae

Crib sheet

TableForm[formulas, TableAlignments → Left, TableHeadings → {Automatic, {"Formula", "Description"}}]

	Formula	Description
1	T	Measurement period
2	A	Number of arrivals
3	C	Number of completions
4	B	Total busy time (i.e., not idle)
5	$\lambda = \frac{A}{T}$	Mean arrival rate
6	$X = \frac{C}{T}$	Mean throughput
7	$S = \frac{B}{C}$	Mean service time
8	$\rho = \frac{B}{T}$	Server utilization
9	$U = \sum_{k=1}^m \rho_k$	Total utilization with m servers
10	$\rho = XS = \lambda S$	Little's law: mean requests in service
11	$Q = XR = \lambda R$	Little's law: mean requests in residence
12	$R = W + S$	Fundamental residence time
13	$R = \frac{S}{1-\rho}$	M/M/1 residence time
14	$R \approx \frac{S}{1-\rho^m}$	M/M/m residence time (Morphing approximation)
15	$R = S + \frac{\rho S}{1-\rho} \frac{C^2+1}{2}$	M/G/1 residence time
16	$Q = \frac{\rho}{1-\rho}$	M/M/1 queue length
17	$R = \frac{N}{X(N)} - Z$	M/M/1/N/N response time
18	$X = \frac{N}{R(N)+Z}$	M/M/1/N/N throughput
19	$C(p) = \frac{p}{1+\sigma(p-1)+\kappa p(p-1)}$	Universal scalability law for hardware processors
20	$C(N) = \frac{N}{1+\alpha(N-1)+\beta N(N-1)}$	Universal scalability law for software processes

Question 1

A grocery store checkout lane is monitored for 120 mins. During that period, 60 customers had their groceries rung up and depart the store. The cashier was seen to be idle 25% of the time.

1. What is the number of arrivals into the checkout lane? State any assumptions.

2. What is the average arrival rate into the checkout lane?
3. What is the average throughput at the checkout lane?
4. What is the cashier utilization?
5. What is the aggregate busy time of the cashier?
6. What is the average service time of the cashier?

Solutions

Question 2

Referring to the grocery store checkout in Question 1:

1. What is the average residence time per customer? State any assumptions.
2. What is the average queue length in the checkout lane?

Solutions

Question 3

The grocery store manager wants you to predict what would happen to the customer residence time if he employed an additional cashier to service the waiting customers in the same checkout lane.

1. Assume the traffic in the store remains the same as it was for the M/M/1 queue.
2. Assume the traffic in the store doubles in the next year.

Solutions

Question 4

A satellite image file takes 1 minute to scan. A computer system needs to be able to scan 75,000 image files per month. Your manager wants you to size an appropriate system for this application and determine its latency performance.

1. What is the minimum system capacity needed to ensure the scan rate is maintained? *Assume this is a 7 x 24 operation with 4 weeks in a month.*
2. What is the average residence time to scan a file with this minimum server capacity? *Assume there is a single queue with 2 servers.*
3. Repeat the procedure used in part 2 to find the number of scanners that would be needed to meet a service level objective of $R = S$ to 4 significant digits.

Solutions

Question 5

Measurements of a UNIX database server, that supports 100 active users, shows that the average response time is 1.5 seconds per transaction. The average CPU time per transaction is found to be 0.30 seconds at 25% CPU time spent in the kernel and 50% in user space. What is the average think time per transaction?

Solution

Question 6

A server supports 70 active clients. You use a stopwatch to estimate the average time between the completion of one client transaction and the submission of the next, and it is found to be around 30 seconds. The paging disk has a measured service demand of 250 milliseconds and is 50% busy. What is the average response time of the server?

Solution

Question 7

A computer system receives transactions at the rate of 8 per second. If each transaction is resident in the system for an average of 0.7 seconds, how many transactions are simultaneously in the computer system?

Solution

Question 8

A hotel bartender knows that, on average, 18 customers per hour arrive at his bar. There are typically 6 customers seated at the bar. What is the average length of time each customer spends at the bar?

Solution

Question 9

In a data communications switch, messages arrive into a buffer for transmission over one of 8 links. The average arrival rate is 10 message every second and it takes 600 milliseconds to transmit on the link. How long does each message spend in the switch?

Solution

Question 10

A country post office only has a single clerk to help customers. Seventy percent of the customers require 1 minute to have their mail serviced, 20 percent take 3 minutes and 10 percent take 10 minutes. Calculate the average time a person can expect to spend in the post office when people arrive at a rate of 1 every 3 minutes?

Hint: Calculate the variance, standard deviation, coefficient of variation, and use M/G/1 formula.

Solution

Mathematica Configuration

\$Version

10.3.1 for Mac OS X x86 (64-bit) (December 9, 2015)