Performance Evaluation of Computer Systems
Part B

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The Intranet of a medium scale company consists of three servers, namely A, B and C, which represent the web browser of the clients, the application server and the database server, respectively. The intranet is modelled by an open queueing network. In order to evaluate the performance of the system a 10 minutes monitoring phase has been performed. The following data have been collected:

C_A	Server A number of completions	500
C_B	Server B number of completions	150
C_C	Server C number of completions	300
C	Network (intranet) completions	75
B_A	Server A busy time	450s
B_B	Server B busy time	300s
B_C	Server C busy time	100s

Compute:

a) the utilizations of all the servers
b) the service demands of all the servers, determine which is the bottleneck
c) the number of visits at server A
d) the service time at server A
e) the arrival rate that saturates the system
f) the response time of server A and the number of requests in A

Consider the closed queueing network composed of servers A, B and C and a delay with Z=10s and the same service demands of the open queueing network.

g) Represent the asymptotic bound X(N) and R(N) on system throughput and response time varying the population size N
h) Determine the minimum number of requests N such that after this value the system is in the heavy load condition.
i) Assume that the system works in the heavy load condition. What is the maximum and minimum system response time?
j) Compute the exact value of system throughput and response time when it is N=3.

Solutions:
1) Ua= 450/600=0.75; Ub= 0.5; Uc= 0.17;
2) Da=450/75=6; Db=4; Dc=1.333; sec, bottleneck: a
3) Va=6/Sa= 6/(450/500)=6.667
4) Sa=450/500=0.9 sec
5) lambda_sat=1/6
6) Ra=Sa/(1-Ua)=3.6 sec, Qa=Ua/(1-Ua)=3.6*75/600=0.45

7) bounds
8) N*=3.52 => N*=4
9) minimo=11.33, massimo=+inf
10) X(1)=0.0468757324, X(2)=0.0838439744, X(3)=0.1113104532