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TRAFFIC SHARING IN A COMPUTER NETWORK USING NUMERICAL TECHNIQUES

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Abstract:- *There are many derivations for the probability of traffic sharing between two operators in computer networks. In this paper, the approximate bounded area and computation of probability using numerical methods, in particular, Simpson's 3/8and Weddle's rule along with the mutual comparisons are given.*

Keywords*: Traffic Sharing, Simpson's3/8 Rule, Weddle's rule, Probability Curve.*

INTRODUCTION

The Internet sharing is a crucial problem in computer networks. The Internet is one of the most widely used tools for accessing the digital information. A user of internet services has a big proposition among all throughout the world. These services are provided by operators (Internet Service Providers) by the help of wide area network in a region. Naldi [1](2002) has suggested a relationship between traffic sharing and blocking probability in a network using Markov chain model under the assumption of two networks operators.[2] Shukla and Thakur (2010) extended the approach by introducing a rest state in the structural setup. Markov Chain Model is a technique of exploring the transition behavior of a system.
[1] has expressed the following relation

$$\overline{P} = (1 - L_1)\frac{p + (1-p)(1-p_A)L_2}{1 - L_1L_2(1-p_A)^2}$$

Where $\overline{P}$ is the traffic share by first operator. O_1, p is user preference, L_1, L_2 are the network blocking probabilities experienced by both the operators O_1 and O_2.
In the above equation L_1 is a variable but all the other parameters p, p_A and L_2 are constants.
[3] Shukla and Thakur have estimated the bounded area of the curve generated by above expression using Trapezoidal rule. The Trapezoidal rule of Numerical integration theory is weak and not suitable for curvilinear relationship. This paper presents the estimation of bounded area by Simpson 3/8 and a comparison between Simpson 3/8 and Weddle's rule.

Methodology:

Consider $I = \int_a^b f(x)dx$, where f(x) is the given function that can be integrated in the interval a to b.

Let us divide the interval [a,b] into 10 equal parts x_0, x_1, x_2,…., x_{10} each of length h= x_i- x_{i-1} ; i=1,2,3,…,10.and $y_0=f(x_0)$, $y_1=f(x_1)$,…, $y_{10}=f(x_{10})$.

Simpson 3/8 rule:

$$I = \int_a^b f(x)dx = \int_a^b ydx = \frac{3h}{8}[(y_0 + y_{10}) + 3(y_1 + y_2 + y_4 + y_5 + y_7 + y_8) + 2(y_3 + y_6 + y_9)]$$

Weddle's Rule:

$$I = \int_a^b f(x)dx = \int_a^b ydx = \frac{3h}{10}[y_0 + 5y_1 + y_2 + 6y_3 + y_4 + 5y_5 + 2y_6 + 5y_7 + y_8 + 6y_9 + y_{10}]$$

Applications:

In the formula

$$\overline{P} = (1 - L_1)\frac{p + (1-p)(1-p_A)L_2}{1 - L_1L_2(1-p_A)^2}$$

L_1 is a variable but all the other parameters p, p_A, and L_2 are constants.

For the variation of L_1, we can find different values of $\bar{P}$ which are given in the tables 1-6. Then the total bounded area can be calculated by using Simpson's3/8 rule (tables1-3; graphs1-3) and Weddle's rule(tables4-6;graphs4-6).

From Table1, we observe that the traffic share is a linearly decreasing function of self network blocking probability. As L_2 increases, the operator O_1 gains the traffic share and we observe very small fluctuation. And the Graph 1 supports the same and displays the linearly increasing trend between $\bar{P}$ *and* L_2.

From Table2, the bounded area level increases with the increase of probability p and it seems traffic share is function of p and L_2.Graph2 represents a straight line with bounded area below the curve increases with increment of p from 18% to 49.5%.

From Table3, with the variation of p_A, the bounded area reduces and it supports that the total bounded area is a function of p, p_A, and L_2 and Graph3 represents the same from 28% to 9%.

In Table4, the bounded area increases and is higher than the area observed by Simpson's rule. Graph 4 shows the increasing bounded area from15% to 40%.

From table5, bounded area increases and higher than the area from Simpson's rule.Graph5 is a straight line from18% to 50%.

Finally, from the table 6, the bounded area decreases and higher than the area obtained from table3.Graph6 shows decreasing area from 28% to 9%.

Conclusion

The bounded area is a function of many parameters under the probability curve. It depends on the variation of parameters .If L_2 and p increases then the area also increases, where as the area decreases as p_A increases.ss

The maximum bounded area by Simpson's rule is 0.495375 at p=0 and the maximum area by Weddle's rule is 0.498 at p=0.9. The values from Weddle's rule are higher than the values from Simpson's 3/8 rule.

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TABLE1- SIMPSON'S 3/8 RULE

P=0.25,p_A=0.35,h=0.1

L_2 / L_1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0.298	0.348	0.396	0.445	0.494	0.543	0.591	0.64	0.689
0.1	0.27	0.315	0.361	0.407	0.454	0.501	0.548	0.596	0.644
0.2	0.241	0.283	0.325	0.368	0.412	0.457	0.503	0.549	0.596
0.3	0.212	0.25	0.288	0.328	0.369	0.411	0.454	0.499	0.544
0.4	0.182	0.216	0.25	0.286	0.324	0.362	0.402	0.444	0.487
0.5	0.153	0.181	0.212	0.243	0.276	0.311	0.347	0.385	0.425
0.6	0.123	0.146	0.172	0.198	0.226	0.256	0.288	0.321	0.357
0.7	0.092	0.111	0.13	0.151	0.174	0.198	0.224	0.252	0.282
0.8	0.062	0.075	0.088	0.103	0.119	0.136	0.155	0.175	0.198
0.9	0.031	0.038	0.045	0.052	0.061	0.07	0.081	0.092	0.105
1	0	0	0	0	0	0	0	0	0
AREA	0.151	0.178	0.206	0.235	0.266	0.297	0.329	0.363	0.397

TABLE2- SIMPSON'S 3/8 RULE

P_A=0.25,L_2=0.35,h=0.1

p / L_1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0.336	0.41	0.484	0.558	0.631	0.705	0.779	0.853	0.926
0.1	0.309	0.376	0.444	0.512	0.58	0.647	0.715	0.783	0.85
0.2	0.28	0.341	0.403	0.464	0.526	0.587	0.649	0.71	0.771
0.3	0.25	0.305	0.36	0.415	0.47	0.524	0.579	0.634	0.689
0.4	0.219	0.267	0.315	0.363	0.411	0.459	0.507	0.555	0.603
0.5	0.186	0.227	0.268	0.309	0.35	0.391	0.432	0.473	0.514
0.6	0.153	0.186	0.219	0.253	0.286	0.32	0.353	0.387	0.42
0.7	0.117	0.143	0.168	0.194	0.22	0.245	0.271	0.297	0.322
0.8	0.08	0.097	0.115	0.132	0.15	0.167	0.185	0.202	0.22
0.9	0.041	0.05	0.059	0.068	0.077	0.086	0.095	0.104	0.113
1	0	0	0	0	0	0	0	0	0
AREA	0.180	0.219	0.259	0.298	0.338	0.377	0.417	0.456	0.495

TABLE3- SIMPSON'S 3/8 RULE

P=0.15, L_2=0.45,h=0.1

p_A / L_1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0.494	0.456	0.418	0.38	0.341	0.303	0.265	0.227	0.188
0.1	0.462	0.423	0.384	0.347	0.311	0.275	0.239	0.204	0.17
0.2	0.426	0.387	0.35	0.314	0.279	0.246	0.214	0.182	0.151
0.3	0.388	0.349	0.313	0.279	0.247	0.217	0.188	0.159	0.132
0.4	0.347	0.309	0.275	0.243	0.214	0.187	0.161	0.137	0.113
0.5	0.302	0.266	0.235	0.206	0.181	0.157	0.135	0.114	0.094
0.6	0.253	0.221	0.193	0.168	0.146	0.127	0.109	0.092	0.076
0.7	0.199	0.171	0.148	0.128	0.111	0.096	0.082	0.069	0.057
0.8	0.14	0.119	0.101	0.087	0.075	0.064	0.055	0.046	0.038
0.9	0.074	0.062	0.052	0.044	0.038	0.032	0.027	0.023	0.019
1	0	0	0	0	0	0	0	0	0
AREA	0.283	0.253	0.225	0.2000	0.177	0.155	0.134	0.114	0.094

TABLE4- WEDDLE'S RULE

P=0.25,p_A=0.35,h=0.1

qL_2 / L_1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0.298	0.348	0.396	0.445	0.494	0.543	0.591	0.64	0.689
0.1	0.27	0.315	0.361	0.407	0.454	0.501	0.548	0.596	0.644
0.2	0.241	0.283	0.325	0.368	0.412	0.457	0.503	0.549	0.596
0.3	0.212	0.25	0.288	0.328	0.369	0.411	0.454	0.499	0.544
0.4	0.182	0.216	0.25	0.286	0.324	0.362	0.402	0.444	0.487
0.5	0.153	0.181	0.212	0.243	0.276	0.311	0.347	0.385	0.425
0.6	0.123	0.146	0.172	0.198	0.226	0.256	0.288	0.321	0.357
0.7	0.092	0.111	0.13	0.151	0.174	0.198	0.224	0.252	0.282
0.8	0.062	0.075	0.088	0.103	0.119	0.136	0.155	0.175	0.198
0.9	0.031	0.038	0.045	0.052	0.061	0.07	0.081	0.092	0.105
1	0	0	0	0	0	0	0	0	0
AREA	0.152	0.1790	0.2070	0.2360	0.267	0.298	0.331	0.365	0.399

TABLE5- WEDDLE'S RULE

P_A=0.25,L_A=0.35,h=0.1

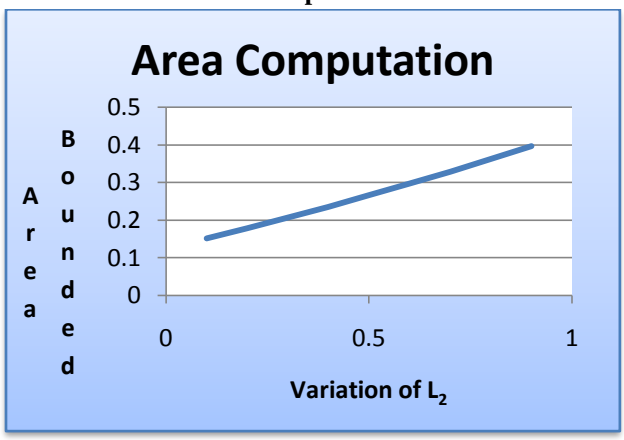
p / L_1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0.336	0.41	0.484	0.558	0.631	0.705	0.779	0.853	0.926
0.1	0.309	0.376	0.444	0.512	0.58	0.647	0.715	0.783	0.85
0.2	0.28	0.341	0.403	0.464	0.526	0.587	0.649	0.71	0.771
0.3	0.25	0.305	0.36	0.415	0.47	0.524	0.579	0.634	0.689
0.4	0.219	0.267	0.315	0.363	0.411	0.459	0.507	0.555	0.603
0.5	0.186	0.227	0.268	0.309	0.35	0.391	0.432	0.473	0.514
0.6	0.153	0.186	0.219	0.253	0.286	0.32	0.353	0.387	0.42
0.7	0.117	0.143	0.168	0.194	0.22	0.245	0.271	0.297	0.322
0.8	0.08	0.097	0.115	0.132	0.15	0.167	0.185	0.202	0.22
0.9	0.041	0.05	0.059	0.068	0.077	0.086	0.095	0.104	0.113
1	0	0	0	0	0	0	0	0	0
AREA	0.181	0.220	0.26	0.299	0.34	0.379	0.419	0.459	0.498

TABLE6- WEDDLE'S RULE

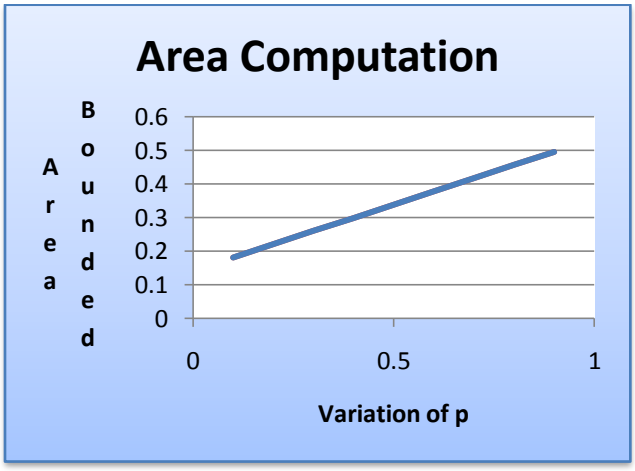
P=0.15, L_2=0.45,h=0.1

p_A / L_1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0.494	0.456	0.418	0.38	0.341	0.303	0.265	0.227	0.188
0.1	0.462	0.423	0.384	0.347	0.311	0.275	0.239	0.204	0.17
0.2	0.426	0.387	0.35	0.314	0.279	0.246	0.214	0.182	0.151
0.3	0.388	0.349	0.313	0.279	0.247	0.217	0.188	0.159	0.132
0.4	0.347	0.309	0.275	0.243	0.214	0.187	0.161	0.137	0.113
0.5	0.302	0.266	0.235	0.206	0.181	0.157	0.135	0.114	0.094
0.6	0.253	0.221	0.193	0.168	0.146	0.127	0.109	0.092	0.076
0.7	0.199	0.171	0.148	0.128	0.111	0.096	0.082	0.069	0.057
0.8	0.14	0.119	0.101	0.087	0.075	0.064	0.055	0.046	0.038
0.9	0.074	0.062	0.052	0.044	0.038	0.032	0.027	0.023	0.019
1	0	0	0	0	0	0	0	0	0
AREA	0.285	0.254	0.227	0.201	0.178	0.156	0.134	0.114	0.095

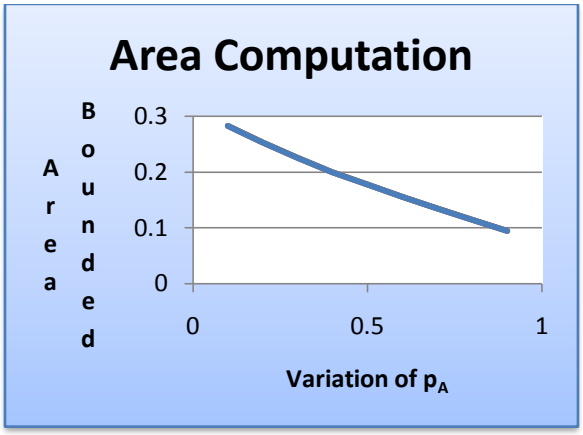
Graph1



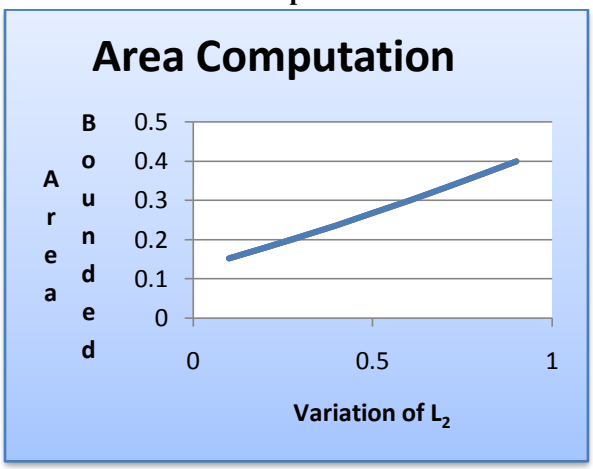
Graph2



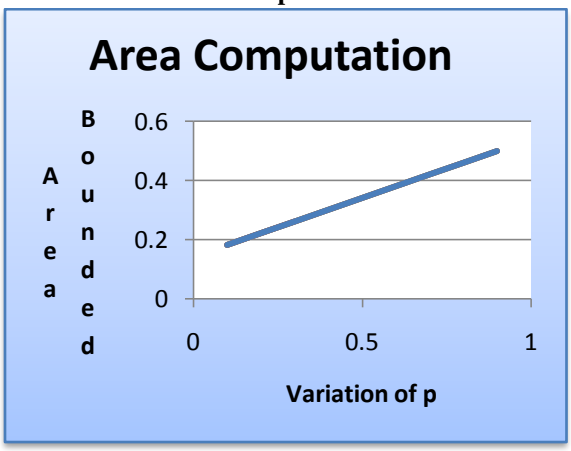
Graph3



Graph4



Graph5



Graph6