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To Find the Alternate Formula for Production Rate Trends to Design for Un-Paced Production Line When Unbalancing the Workloads

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Abstract – In this study we find out the Alternate formula for production rate. We know the actual Production rate of from the all 60 out comes from we find out from the C programming computation. But the computation for large (more than 5 station un-paced production) un-paced production line is difficult therefore we make an arrangement from this study to design an assembly line/ production who is working efficiently from this easiest formula.

Keyword – Production rate, bowl phenomenon, workloads μ 1 to μ5, Alternate formula for production rate (AFR), Work station, un-paced production line.

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INTRODUCTION

In Un-paced production line there are prediction of production line rate to calculate develop the mathematical (Jamali, 2002. Ziaulhaq, et. al., 2015) formula. There are for 2 station the formula for production rate calculated manually the formula (Jamali, 2002) are when we solve the equation when we found these 3equation through exponential distribution strategy to solve the un-paced line for steady state. Solving the three algebraic equations is easy task but for developing 5 station production line found the 55 algebraic equations we found solving it a difficult task therefore we solve it by C programing (Jamali, 2002. Ziaulhaq, et. al., 2015). There for 2 station un-paced production line the formula are given below

We know that αi = mean operation rate at station i

Where αi = 1/μi

Where μi (mu) = mean operation time at station i : i=1,2

Where R= production rate of the line

$R = \alpha1 X \alpha2(\alpha1+\alpha2)/(\alpha1^2 + \alpha2^2 + \alpha1 X \alpha2)$

In for designing un-paced production line more than 7 station large algebraic equation generate this is not easy solve to find the production rate of line. Therefore from result of 5-station production we gave an alternate formula to find out the trends of effective ness in this formula to 5 station line. We found it the trends is effective when we see the graphs of un-paced line rate and the alternate formula production line.

THEORY

Many Researchers Find the Optimal Bowl distribution of workload (Hiller, and So, 1993) and degree of closeness (Jamali, 2016) or when the optimal bowl is unknown (Jamali & Suhail, 2016) to the 5-station to the bowel phenol menon.in 5 station un-paced production line with exponentially distributed operation time. From the bowel phenomenon we see that in the μi (mui) = mean operation time at station i: (i=1,2,3,4,5) If we use only last and first operation station time behavior of worker in the line we say that the two station time is important for designing the Un-paced production line other station behavior is less impact on the un-paced production line. Therefore for calculation this production line is called as Alternate formula for calculating the rate. To find the alternate production rate we take the formula as fallows

Alternate formula Rate = (μ1 + μ 5)/total time in production line

In table for μ1= Mu1; μ2= Mu2; μ3= Mu3; μ4= Mu4; μ5= Mu5

We calculate the production rate from C programming (Jamali, 2002. Ziaulhaq, et. al., 2015) and alternate production rate (AFR) through this formula given in tables.

We see the trends in graphs developed in to serial number VS production rate (R) and alternate formula production rate (AFR) from different outcomes of workloads distribution linearly and randomly from different data set. We found that for different values of degree of imbalance D (the difference between highest operation times to the lowest operation time)

Example for table 1 (D= μ5 – μ4: D= 1.9- 0.1 = 1.8)

In Table one the degree of imbalance is D= 1.8

Here highest work load on work station 5 is 1.9 and lowest workload on station 4 is 0.1

Therefore the degree of imbalance is equal to D=1.8

Tables and Graph

Table1. Alternate formula rate, Production Rate when work load distribution linear are D= 1.8

S.N0.	Mu1	Mu2	Mu3	Mu4	Mu5	R	AFR
1	1.45	0.55	1	0.1	1.9	0.436	0.67
3	1.45	1	0.1	0.55	1.9	0.4308	0.67
5	1	1.45	0.55	0.1	1.9	0.428	0.58
10	1.9	0.1	1	1.45	0.55	0.4187	0.49
15	1	1.9	0.55	0.1	1.45	0.4128	0.49
20	1.45	0.1	1	1.9	0.55	0.4079	0.4
25	0.1	1.45	0.55	1	1.9	0.4027	0.4
30	1	1.9	0.55	1.45	0.1	0.3928	0.22
35	1.45	1.9	0.1	1	0.55	0.3876	0.4
40	0.55	1.9	1.45	0.1	1	0.3846	0.31
45	1.45	1	1.9	0.55	0.1	0.3826	0.31
50	1	1.45	1.9	0.1	0.55	0.3747	0.31
55	0.1	1	1.45	1.9	0.55	0.3717	0.13
60	0.55	1.45	1.9	1	0.1	0.3694	0.13

Table 2. Alternate formula rate, Production Rate when work load distribution linear are D=1.2

S.N0.	Mu1	Mu2	Mu3	Mu4	Mu5	R	AFR
1	1.6	0.4	1	0.7	1.3	0.469	0.58
3	1.3	1	0.4	0.7	1.6	0.4661	0.58
5	1.6	0.4	0.7	1.3	1	0.4623	0.52
10	1.6	0.4	1	1.3	0.7	0.4544	0.46
15	1.6	0.4	1.3	1	0.7	0.4504	0.46
20	1.3	0.4	1	1.6	0.7	0.4451	0.4
25	1.6	1	0.7	1.3	0.4	0.441	0.4
30	0.7	1	0.4	1.3	1.6	0.4367	0.47
35	0.4	1	1.6	0.7	1.3	0.4314	0.34
40	1	0.4	1.3	1.6	0.7	0.4288	0.34
45	1.3	1.6	0.7	1	0.4	0.4244	0.34
50	0.7	0.4	1.6	1.3	1	0.4208	0.34
55	0.4	0.7	1	1.6	1.3	0.4155	0.34
60	0.4	1	1.6	1.3	0.7	0.4131	0.275

Table 3. Alternate formula rate, Production Rate when work load distribution linear are D=0.3

S.N0.	Mu1	Mu2	Mu3	Mu4	Mu5	R	AFR
1	1.075	1	0.85	0.925	1.15	0.4906	0.445
3	1.15	0.85	0.925	1	1.075	0.4901	0.445
5	1.15	1	0.925	0.85	1.075	0.4894	0.445
10	1	1.15	0.85	0.925	1.075	0.4863	0.415
15	1.15	0.85	1	1.075	0.925	0.4853	0.415
20	1	0.925	1.15	0.85	1.075	0.4841	0.415
25	1.075	0.85	1	1.15	0.925	0.4829	0.4
30	1	1.150	0.85	1.075	0.925	0.4821	0.385
35	0.85	1.15	1	0.925	1.075	0.4808	0.385
40	0.85	1	0.925	1.15	1.075	0.4796	0.385
45	0.85	1.075	0.925	1.15	1	0.4787	0.37
50	1	0.925	1.075	1.15	0.85	0.4776	0.37
55	0.85	0.925	1.15	1.075	1	0.4756	0.37
60	0.925	1.075	1.15	1	0.85	0.474	0.355

Table 4. Alternate formula rate, Production Rate when work load distribution linear are D= 0.1

S.N0.	Mu1	Mu2	Mu3	Mu4	Mu5	R	AFR
1	1.05	0.975	0.95	1	1.025	0.4882	0.415
3	1.05	0.95	0.975	1	1.025	0.4879	0.415
5	1.025	0.975	1	0.95	1.05	0.4878	0.415
10	1.05	1.025	0.975	0.95	1	0.487	0.41
15	1.025	1.05	0.95	0.9751	1	0.4866	0.405
20	1.05	0.95	1.025	1	0.975	0.486	0.405
25	1.05	1	1.025	0.95	0.975	0.4858	0.405
30	1.05	0.975	1	1.025	0.95	0.4854	0.4
35	0.95	0.975	1	1.025	1.05	0.4851	0.4
40	0.95	1	0.975	1.05	1.025	0.4847	0.395
45	0.95	1.05	0.975	1.025	1	0.4842	0.39
50	1.025	1	1.05	0.975	0.95	0.484	0.395
55	0.975	1.025	1	1.05	0.95	0.4832	0.385
60	0.95	1	1.05	1.025	0.975	0.4826	0.385

Table 5. Alternate formula rate, Production Rate when work load distribution random are D= 1.9

S.No.	Mu1	Mu2	Mu3	Mu4	Mu5	R	AFR
1	2	0.3	0.6	0.1	2	0.4022	0.8
3	2	0.1	0.3	0.6	2	0.3992	0.8
5	2	0.3	0.1	0.6	2	0.3984	0.8
10	0.6	2	0.1	0.3	2	0.3878	0.52
15	2	0.3	0.6	2	0.1	0.3805	0.42
20	0.6	0.3	2	0.1	2	0.3711	0.52
25	0.6	2	0.1	2	0.3	0.3669	0.18*
30	0.1	2	0.3	2	0.6	0.3632	0.14*
35	0.1	2	0.6	2	0.3	0.356	0.08*
40	0.3	0.6	0.1	2	2	0.3328	0.46
45	2	2	0.3	0.6	0.1	0.3321	0.42
50	0.3	0.1	0.6	2	2	0.3297	0.46
55	0.3	0.6	2	2	0.1	0.3296	0.08*
60	0.1	0.6	2	2	0.3	0.3293	0.08*

*value of last station and first station are very low therefore the AFR are very low

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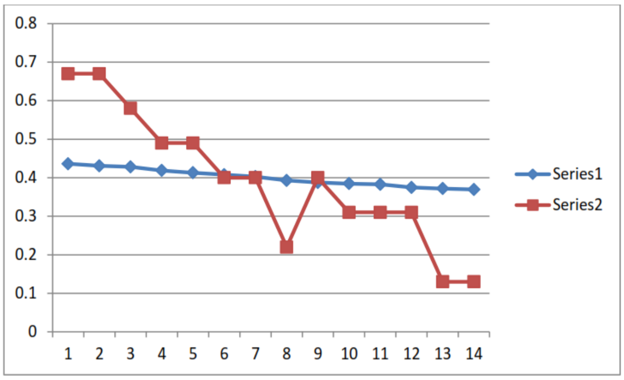
Table 6. Alternate formula rate, rate of production line when work load distribution random are D= 0.4

S.N0.	Mu1	Mu2	Mu3	Mu4	Mu5	R	AFR
1	1.1	1.1	0.7	1	1.1	0.4875	0.44
3	1.1	1.1	0.7	1	1.1	0.4784	0.44
5	1.1	1.1	0.7	1	1.1	0.4875	0.44
10	1	1.1	0.7	1.1	1.1	0.485	0.42
15	1.1	0.7	1.1	1	1.1	0.4841	0.44
20	1.1	1.1	1	0.7	1.1	0.4839	0.44
25	1	1.1	1.1	0.7	1.1	0.4811	0.42
30	1.1	0.7	1.1	1.1	1	0.4811	0.42
35	1.1	1.1	1.1	0.7	1	0.4788	0.42
40	0.7	1.1	1	1.1	1.1	0.472	0.36
45	1.1	1	1.1	1.1	0.7	0.4717	0.36
50	1.1	1.1	1.1	1	0.7	0.4697	0.36
55	0.7	1.1	1.1	1.1	1	0.4686	0.36
60	1	1.1	1.1	1.1	0.7	0.4686	0.36

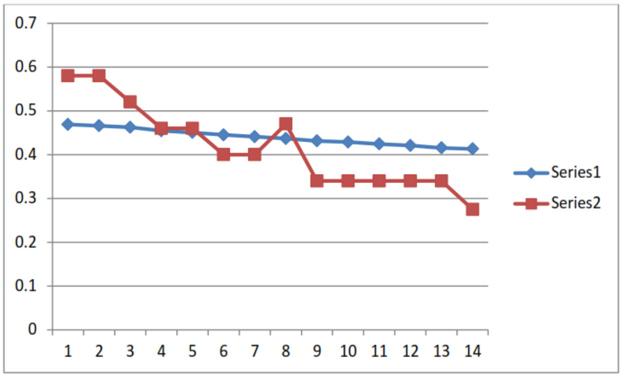
Graph For series 1 Rate(R) , For series 2 Alternate Formula rate (AFR)

For S. No. 1 to 60 in table is mention as 1 to 14 in graph in horizontal

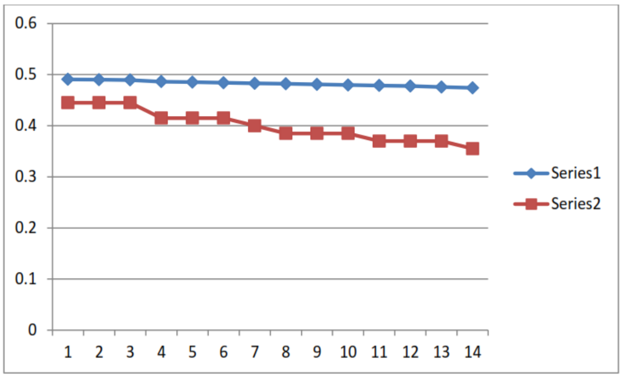
For linear value D= 1.8



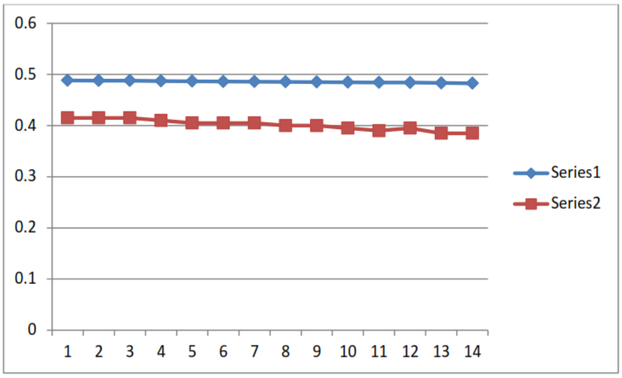
For linear value D=1.2



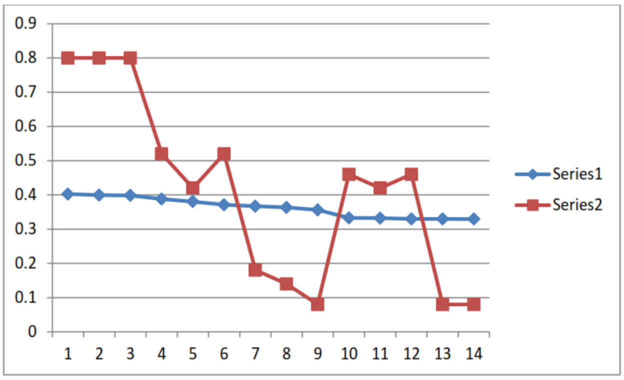
For linear value D= 0.3



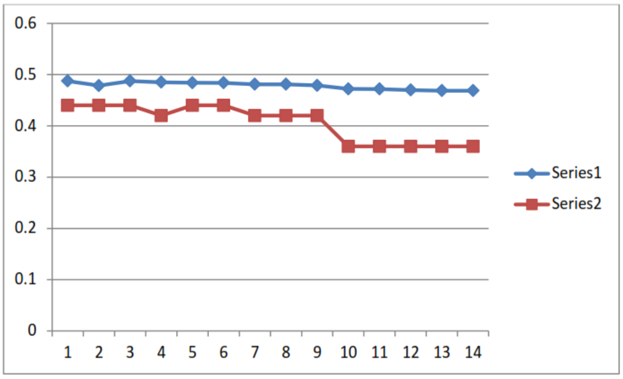
For linear value D=0.1



Random value D=1.9



Random value D = 0.4



RESULT

1. From graph we see that the trends of Alternate production rate is same as the trends in production rate.

2. For unbalancing the line D= 1.8 linear distribution of workloads in station or D=1.9 random distribution or higher the value of imbalance like D=1.2 or D=1 in linear or random distribution of workload distribution the graph nature of alternate formula of production rate is same as the production rate formula

3. For Low degree of imbalance like D= 0.4 to 0.3 for linear or random values the alternate formula the curve or graph is above to the production rate formula

CONCLUSION

From the above results we say that the alternate formula is effective for designing the bigger assembly line without using the computer or software. It is easy and designer who know the assembly line/ production line arrange the work-station easily according to the work.

SCOPE

1. This formula is checked for designing the robotic assembly line for practical uses of the work load distribution when the work process done by the expert operator by manually.

2. Also find out the production rate of the assembly line/ production line when the batch size, operation time, setup time know for any products assembly.

3. We also estimate the cost of production to develop the software

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