SYSC 5001W: Project deliverable 4

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1 An Alternative Operating Policy

1.1 Purpose

We've got the data statistic of the model we have and we want to do some improvement on it. Here I would like to propose a new algorithm that the system follows and performs better than the origin one. The new proposed one would be more efficient which means the total finish time would be shorter and components take less time in the buffer. The work flow would take less time to product the same number of products and in some way it would save a lot of money.

1.2 A More Efficient Policy

At first, let's consider about what it would be if we put that inspector 1 first output to satisfy workstation 2 and workstation 3 so the output of workstation would be more fluent and it may costs less time. As the original policy said, Inspector 1 routes components C1 to the buffer with the smallest number of components in waiting (i.e., a routing policy according to the shortest queue). In case of a tie, W1 has the highest and W3 the lowest priority. Now we change it to that Inspector 1 routed components C1 to the buffer with the workstation 2 first and then to the workstation 3. In this case, Inspector 2 has the highest priority and then Inspector 3 and Inspector 1 has the lowest priority.
The code is not hard to modify and we just need to change the rule of distribution of Inspector 1.
The total time of production may be not changed so much but the block time and idle time would vastly decreased which means the efficient of each inspectors and workstation would be better. Basically, the less idle time in the model indicates that less consumption in the reality. Especially, the number of product 2 and product 3 would be increased and the ratio of three products would be balanced.

1.3 Compare two models

We would like to compare these two models which is better so we do the same things for these two and compare. We already did ten replications for the original model and we have to do the same thing for the altered one.
The purpose is to compare alternative system designs. The method of comparing is replications is used to analyze the output data.
We declare how to compare performance of two models here. The mean performance measure for system is denoted by θ_1 and the modified one is denoted by θ_2. To obtain point and interval estimates for the difference in mean performance, namely$\theta_1 - \theta_2$. We formulate the rule here the main measurement is which model has less idle time for workstation and inspectors and which model has less block time in the buffer.
We compute the confidence interval for $\theta_1 - \theta_2$:

- If c.i. is totally to the left of 0, strong evidence for the hypothesis that $\theta_1 - \theta_2 < 0(\theta_1 < \theta_2)$.
- If c.i. is totally to the right of 0, strong evidence for the hypothesis $\theta_1 - \theta_2 > 0((\theta_1 > \theta_2)$.
- If c.i. is totally contains 0, no strong statistical evidence that one system is better than the other

We also formulate that the confidence interval, we have $\alpha = 0.05$, for $\theta_1 - \theta_2$always takes the form of:

$$\bar{Y}_1 - \bar{Y}_2 \pm t_{\alpha/2}(\bar{Y}_1 - \bar{Y}_2) \tag{1}$$

Different and independent random number streams are used to simulate the two systems. All observations of simulated system 1 are statistically independent of all the observations of simulated system 2.
The variance of the sample mean is:

$$V(\bar{Y}_i) = \frac{V(Y_i)}{R_i} = \frac{\delta_i^2}{R_i} \tag{2}$$

For independent samples:

$$V(\bar{Y}_1 - \bar{Y}_2) = \frac{\delta_1^2}{R_1} + \frac{\delta_2^2}{R_2} \tag{3}$$

Here we have model 2 do the same number of replications we don't need to do verification. I just list all statics I got below.

The we compare these two kind of model and analyze their correlated confidence intervals.

Table 1: Replications of simulations

Replications	1	2	3	4	5
Inspector 1 mean time	10.367	10.051	10.693	9.82	10.796
Inspector 2 mean time	17.278	17.554	19.155	17.062	18.687
No. in Buffer W1C1	0.053	0.052	0.052	0.037	0.029
No. in Buffer W2C1	0.679	0.828	0.806	0.725	0.701
No. in Buffer W2C2	0.312	0.316	0.387	0.295	0.253
No. in Buffer W3C1	0.557	0.555	0.582	0.514	0.484
No. in Buffer W3C3	0.317	0.354	0.351	0.412	0.307
Wait time W1C1	1.235	1.144	1.141	0.808	0.705
Wait time W2C1	22.376	28.86	30.07	24.482	23.387
Wait time W2C2	10.311	11.06	14.422	9.966	8.599
Wait time W3C1	21.294	22.285	25.436	20.473	18.86
Wait time W3C3	12.087	14.199	14.578	15.793	11.973
No. P1	125	142	142	133	132
No. P2	94	85	85	90	91
No. P3	81	73	73	77	77
Idle % Inspector 1	0.001	0.018	0.005	0.029	0.066
Idle % Inspector 2	0.028	0.074	0.056	0.68	0.046
Idle % Workstation 1	0.798	0.901	0.797	0.818	0.84
Idle % Workstation 2	0.701	0.661	0.714	0.662	0.676
Idle % Workstation 3	0.787	0.784	0.803	0.787	0.803
Replications	6	7	8	9	10
Inspector 1 mean time	10.777	9.488	9.538	10.152	12.502
Inspector 2 mean time	19.607	17.451	20.067	21.417	17.34
No. in Buffer W1C1	0.026	0.042	0.041	0.056	0.029
No. in Buffer W2C1	0.731	0.869	0.887	0.89	0.741
No. in Buffer W2C2	0.221	0.417	0.369	0.242	0.29
No. in Buffer W3C1	0.595	0.654	0.618	0.872	0.545
No. in Buffer W3C3	0.281	0.246	0.173	0.116	0.478
Wait time W1C1	0.577	0.779	0.752	1.007	0.732
Wait time W2C1	26.423	31.245	32.488	36.259	26.835
Wait time W2C2	7.397	14.879	11.553	9.822	10.538
Wait time W3C1	25.505	17.187	26.75	39.732	22.651
Wait time W3C3	12.184	9.855	7.057	5.094	20.051
No. P1	133	153	155	161	123
No. P2	94	79	78	76	95
No. P3	81	68	67	63	82
Idle % Inspector 1	0.001	0.003	0.037	0.005	0.005
Idle % Inspector 2	0.028	0.102	0.021	0.038	0.105
Idle % Workstation 1	0.798	0.788	0.782	0.769	0.848
Idle % Workstation 2	0.701	0.689	0.706	0.761	0.694
Idle % Workstation 3	0.787	0.774	0.844	0867	0.81

2 Conclusion

The good performance of model is essential for production industry. Less idle time brings more profits to companies so formulating an optimized model solution before production is important.