ISSN 1684 – 8403
Journal of Statistics
Vol: 12, No.1 (2005)

Selection of Single Sampling Plan on the Basis of AQL, AOQL, ATI and LTPD: A Case-Study on Haleeb Foods Ltd., Lahore

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Abstract:

The Haleeb Foods Limited (HFL) is taking care of quality of production by using acceptance sampling procedures. To check the validity of sampling plan adopted by HFL, 30 sampling plans are compared with respect to AQL, AOQL, ATI and LTPD. The results and conclusions show that quality is always towards an improvement trend. The technology is no more the superiority as it is accessible to every one. Investigation and reduction in variations are key to process improvement. For HFL a single sampling plan with N=2700, n=30 and c=1 is suggested, for better quality products. The proposed sampling plan will provide decrease in AQL, AOQL & LTPD by 11.36%, 10.83%, & 9.74%, respectively. The 6.35% increase in ATI is negligible. Thus, the proposed single sampling plan shows improvements with respect to producer's risk, consumer's risk and lot tolerance percent defective for P_{10}.

Key Words: Single Sampling Plan, Operating Characteristic Curve, Acceptance Quality Level, Average Outgoing Quality Level, Lot Tolerance Percent Defective, Average Total Inspection, Consumer's Risk, Producer' Risk.

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1 Introduction:

Any single sampling plan (SSP) requires three numbers to be specified. The lot size, sample size and acceptance number. These are denoted by N, n and c, respectively. To select an appropriate sampling plan the following parameters are to be considered: Acceptance Quality Level (AQL), Average Outgoing Quality Limit (AOQL), Average Total Inspection (ATI) and Lot Tolerance Percent Defective (LTPD) with respect to specified producer's and consumer's risk.

Haleeb Foods Limited (HFL) is a fast growing food product company. Its brief introduction is given by Khan, Pervaiz and Azad (2005). At Haleeb Foods Limited for SSP takes: N = 2700, n = 27 and c = 1.

The objective of this paper is to critically review the sampling plan being used by HFL and make suggestions for improvement, if possible.

Among many others, Steve (2003)

2 Research Methodology:

For critical review of the SSP adopted be the HFL many plans are considered. For the same N = 2700, the samples of size n = 10, 20, 27, 30, 40 & 50 and c = 0, 1, 2, 3 & 4 are considered. Thus, the 30 SSP's are explored. The Type B Operating Characteristic (OC) curves are derived by using the Binomial Probability Distribution. Based on these 30 OC curves the parameters AQL, AOQL, ATI and LTPD are obtained as defined by Grant and Leavenwortf (1996).

The AQL is the maximum % defective that can be considered satisfactory as a process average. The AOQ represents the average outgoing quality. The maximum value of AOQ is referred as AOQL. The ATI represents the average total inspection. The

process quality for which $P_a = 0.10$ is referred as the lot tolerance fraction defective (LTPD).

3 Statistical Analysis:

To compare the SSP adopted by HFL with other proposed 30 SSP's the estimates of parameters AQL, AOQL, ATI and LTPD are obtained. These are as given in Table A 1.

The AQL decreases as **n** increases for all values of c. There is very obvious decrease in AQL with the increase in n from 10 to 27 for all values of c. In comparison of sample of size 30 or more the decrease in AQL is not very obvious even for c=4. For fixed value of n, AQL increases with the increase in c. This increase becomes very high for c= 2, 3 & 4. Of course, it is not necessary that for best sampling plan c should be 0 or 1. Moreover, one can go beyond that especially for samples of size 30 or more. But in this case for n=27, AQL is 232% more for c=2 as compared with c=1. Therefore $c \leq 1$ is suggested. For SSP of HFL, producer risk (α) = 5% has 1.32% AQL. The plan passing through the points $P_{0.95}$ = 1.32%. Therefore the plan will ensure that product 1.32% defective will be rejected 5% of the time and accepted 95% of the time. As sample size increases it gives protection against rejection of good ones as it gives 11% decrease in the AQL for n=30. So if HFL increases sample size from 27 to 30, the maximum % defective considered satisfactory as a process average at 5% producer's risk will be decreased 11%. Thus, for good quality product the producer's risk will be decreased.

There is an increase in AOQL by the increase in the value of c for $n \geq 10$. For n=27 there is 164% increase in AOQL when c=2 as compared with c=1. Thus there is no need to consider c > 1. The AOQL decreases with very high rate with the increase in n for all the values of c. As in the case of AQL, there is decrease in AOQL i-e. 11% for c=1 with n=30 as compared with n=27 for the same value of c. It decreases the consumer's risk of getting defective items. So it is confirmed that n = 30 is more appropriate than n = 27 as regards producer's as well as consumer's risk.

The ATI decreases with the increase in c for all the values of n. To get ATI a reasonable proportion it is suggested that c should not be ≥ 1. For single sampling, plan, ATI for both producer and consumer at 10% nonconforming increases as sample size increases for a given value of c and decreases for all values of c. For SSP of HFL, ATI = 2078. For n = 30, ATI = 2210, which is just 6% more. Keeping in view the performance of proposed sampling plan with respect to reduction in producer's and consumer's risk the 6% increase in ATI is negligible.

For consumer's risk P_a = 0.10 the reject able quality level decreases with increase in sample size for all the values of c. It increases with the increase in c for fixed n. For SSP of HFL, LTPD = 13.65%.That is, 13.65% defective lot will be accepted 10% of the time. For the proposed SSP LTPD = 12.32%. It implies that proposed SSP provides 9.74% decrease in the LTPD. Therefore, n=30 is more appropriate than n = 27, in this respect as well.

4 Conclusions:

As mentioned before HFL is using SSP, i.e. N = 2700, n=27 and c = 1. On the basis of the comparative study it is found that if n is increased as 30 keeping N and c same the decrease in AQL, AOQL & ATPD is 11.36%, 10.83% and 9.74%, respectively. The 6.35% increase in ATI can be ignored. Thus the proposed sampling plan provides reduction in producer's risk, consumer's risk and in lot tolerance percent defective for P_{10}.

References:

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APPENDIX

Table-A1: The AQL, AOQL, ATI and LTP for N=2700,n=10,20,27,30,40,50 ,c=0,1,2,3,4 with α=5% and β=10%

n		C=0	C=1	C=2	C=3	C=4
10	**AQL**	0.50%	3.65%	8.72%	14.98%	22.24%
	AOQL	3.72%	8.81%	14.87%	21.83%	29.60%
	ATI	1762	720	199	44.42	14.4
	LTPD	20.54%	33.65%	44.94%	55.17%	64.57%
20	**AQL**	0.27%	1.79%	4.21%	7.13%	10.38%
	AOQL	1.83%	4.28%	7.09%	10.20%	13.56%
	ATI	2374	1650	886	376	136
	LTPD	10.87%	18.09%	24.46%	30.39%	36.06%
27	**AQL**	0.17%	1.32%	3.06%	5.20%	7.57%
	AOQL	1.36%	3.14%	5.16%	7.43%	9.83%
	ATI	2545	2078	1405	781	365
	LTPD	8.13%	13.65%	18.50%	23.09%	27.43%
30	**AQL**	0.16%	1.17%	2.76%	4.69%	6.79%
	AOQL	1.22%	2.80%	4.65%	6.65%	8.79%
	ATI	2587	2210	1602	971	499
	LTPD	7.35%	12.32%	16.76%	20.09%	24.87%
40	**AQL**	0.09%	0.87%	2.96%	3.46%	5.06%
	AOQL	0.92%	2.10%	3.43%	4.92%	6.49%
	ATI	2661	2486	2107	1574	1027
	LTPD	5.57%	9.35%	12.75%	15.94%	18.98%
50	**AQL**	0.09%	0.68%	1.65%	2.76%	4.02%
	AOQL	0.72%	1.65%	2.75%	3.90%	5.14%
	ATI	2686	2610	2404	2037	1557
	LTPD	4.5%	7.54%	10.3%	12.9%	15.4%