Journal of Mathematical Problems, Equations and Statistics

E-ISSN: 2709-9407
P-ISSN: 2709-9393
JMPES 2023; 4(2): 01-08

www.mathematicaljournal.com
Received: 02-04-2023
Accepted: 05-05-2023

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Construction of acceptance sampling plans for the quartile ranked set sampling using Laplace distribution

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DOI: https://doi.org/10.22271/math.2023.v4.i2a.95

Abstract
The ranked set sampling method has been made more inclusive in this paper. In order to estimate the quartile ranked set sampling of the Laplace distribution, the generalized ranked set sampling technique is used. Two key factors are taken into account for the new course of action: the data are selected using the Quartile Ranked Set inspecting plan from a significant portion, and the lifetime of the test units is acknowledged to follow the summary noteworthy dissemination. The base number of set cycles and, consequently, the base sample size are crucial to ensuring that the predefined normal life are acquired and the working trademark advantages of the positioned examining plans only, as the appropriation work portrayal under the Quartile Ranked Set inspecting plan is determined expecting that the set size is known.

Keywords: Quartile ranked set sampling, acceptance sampling plans, Laplace distribution, operating characteristic function value, producer's risk, consumer's risk

Introduction

Sampling for Ranked Set (RSS) was suggested by McIntyre (1952) [7]. In the essential stage, m autonomous Simple Random Sample (SRS) all of size m are drawn from a given part, and a short time later a free cost situating part is used to rank the units inside each sr. In the resulting stage, the things picked purposely; so much that the thing with the chief position is looked over the essential SRS, and a while later in the second SRS the thing with rank two is picked, etc. till the unit with the best position is browsed the last SRS (Takahasi and Wakimoto, 1968; Sinha *et al*., 1996) [8-9].

RSS can be used in various clinical, agricultural and moderate fields. The fundamental point of this article is to involve the RSS in acknowledgment testing research region as opposed to further developing the RSS conspire. Regardless, none of the past examination pondered any of the RSS thoughts in the acknowledgment testing setting, this article could be considered as another commitment in this functional exploration region.The technique for the old-style Acceptance Sampling Plan (ASP) in light of an SRS comprises of the resulting steps:

Step 1: Draw an SRS of size 'n' items from a large lot.

Step 2: Classify each item within the selected sample as defective or non-defective item.

Step 3: If the number of defective items exceeds the acceptance number(c), then the entire lot is rejected: otherwise, it is accepted.

In this way, in developing any acknowledgment examining plan to figure out the base sample size (n) to acknowledge a lot and the acceptance number(c), likewise utilize single testing plans by ASP (n, c). Generally, with each ASP (n, c), the issue is to track down the obscure boundary n and c that fulfils:

$$P\,(X \le c/n, p_1) = 1 - \alpha$$

$$P\,(X \le c/n, p_2) = \beta \qquad (1)$$

Where α is the Type I mistake and β is the Type II mistake. Besides, p1 is as far as quality limit for acceptable (AQL) and p2 is the percent defective for lot tolerance (LTPD). The issue that we are presenting in this message is with recollecting the QRSS in picking the things from a huge parcel expecting under the Laplace distributions. The huge thought of the usage of

QRSS in acknowledgment examining setting is to cut down the maker peril that risings while the contraptions picked through the normal ASP (n,c) basically reliant upon a SRS strategies Muttak (2003) proposed quartile Ranked set testing (QRSS) to gauge the populace mean and he showed that utilizing QRSS method will lessen the blunders in positioning contrasting with RSS since select and quantify the first or the third quartile of the example. In this paper the Construction of Acceptance Sampling Plans for the Quartile Ranked Set Sampling using Laplace Distribution is proposed.The steps of choosing QRSS are as follows:

- The quartile ranked set sampling procedure as suggested by Muttlak [1] can be summarized as follows. Randomly select n samples each of size n units from the target population and rank the units within each sample with respect to the variable of interest.
- If the sample size n is even, select and measure from the first n/4 samples the Q1(n + 1)th smallest ranked unit of each sample, i.e., the first quartile, and from the second 3*n/4 samples the Q3(n + 1)th smallest ranked unit of each sample, i.e., the third quartile. Always take the nearest integer of Q1(n + 1)th and Q3(n + 1)th where Q1 = 25%, and Q3 = 75%.
- If the sample size n is odd, select and measure from the first (n − 1)/4 samples the Q1(n + 1) th smallest ranked unit of each sample and from the other 3(n − 1)/4 samples the Q3(n + 1) th smallest ranked unit of each sample, and from one sample the median for that sample.
- The cycle can be repeated m times if needed to get a sample of size 'm*r' units

Now, let X_{11}, X_{12},., X_{1m}; X_{21}, X_{22},., X_{2m};. ; X_{m1}, X_{m2},., X_{mm}be m independent SRS each of size m; then among the m samples, select the minimum measurement unit from the first SRS and the second minimum unit from the second SRS, continuing in the same process until we select the maximum measurement unit from the last SRS for actual measurement. The element of the favoured QRSS pattern will be inside the shape:

$\{X_{[n-1/4,\, n]ij}$; i= 1,2,.m, j=1,2,.,r$\}$ n is odd
$\{X_{[n/4;n]ij}$, $X_{[n-1/4;n]kj}$; i=1,2,.,m/4; k=m/4+1,.m, j= 1,2,.r$\}$ n is even

The ith order statistic is given by,

$$F_{X(i)} = (F(x))^{i-1}(1-F(x))^{n-i}, -\infty<x<\infty \quad (2)$$

Therefore, Quartile Ranked Set Sampling is given by

$$F_{QRSS(x)} = (F(x))^{m}(1-F(x))^{m} \quad (3)$$

Where F(x) is denoted by 'q_1' and 1-F(x) is denoted by 'q_3'. Most of investigations of positioned insights have been ranked data with assessing the population mean.

Characterization of the Laplace Distribution under QRSS

In this portion, the appropriations could be re described fundamentally dependent on the QRSS. The effect of the shape parameter on the distribution structure under QRSS using Laplace distribution

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Characterization of the Laplace Distribution for SRS

$$f(x, \mu, b) = \frac{1}{2b}\left(exp\frac{-|x-\mu|}{b}\right) \quad (4)$$

Characterization of the Laplace distribution for QRSS

$$f_{QRSS}(x)=\frac{1}{2b}\left(exp\frac{-|x-\mu|}{b}\right)^{m}\left(1-exp\frac{-|x-\mu|}{b}\right)^{m} \quad (5)$$

Operating Characteristic (OC) Curve

Related with each reviewing plan there is an OC curve which portrays the show of the examining plan against perfect and inferior quality. The probability that a great deal will be recognized under a given inspecting plan which is demonstrated by Pa(p) and a plot of Pa(p) against given worth of part or cycle quality p will yield the OC bend. For one of a kind explanation plans the OC curve, a bend showing the likelihood of continuing to permit the cooperation to happen without change as an element of the interaction quality.
The curve plots the probability of accepting the lot (Pa) versus the lot fraction defective (p)

$$Pa = P\ \{d\leq c\} = \sum_{i=0}^{c} p^{i}1-p^{n-i} \quad (6)$$

Laplace distribution for QRSS will be

$$Pa=\sum_{i=0}^{c}\frac{1}{2b}\left(exp\frac{-|x-\mu|}{b}\right)^{i}\left(1-exp\frac{-|x-\mu|}{b}\right)^{(n-i)} \quad (7)$$

The given table shows the OC curve values for QRSS using Laplace distribution for N=1000,
m = 50, s= 20, r= 1, 2, 3, 4, 5, 6 and n= 50, 100, 150, 200, 250 and 300.

Table 1: The OC Curve Values for Laplace Distribution using QRSS

N	1m	2m	3m	4m	5m	6m
P	**C=0**					
0.010	0.998458	0.996919	0.995383	0.993848	0.992316	0.990786
0.015	0.99746	0.994926	0.992398	0.989877	0.987362	0.984854
0.020	0.995815	0.991647	0.987497	0.983364	0.979248	0.97515
0.025	0.993108	0.986264	0.979467	0.972717	0.966014	0.959356
0.030	0.988661	0.977451	0.966367	0.95541	0.944576	0.933866
0.035	0.981369	0.963084	0.945141	0.927531	0.91025	0.893291
0.040	0.969453	0.93984	0.911131	0.883299	0.856317	0.83016
0.045	0.950099	0.902688	0.857642	0.814845	0.774183	0.735551
0.050	0.918963	0.844493	0.776058	0.713169	0.655376	0.602266
0.055	0.869672	0.756329	0.657758	0.572033	0.497481	0.432645
P	**C=1**					
0.010	0.998582	0.997042	0.995505	0.993971	0.992439	0.990909
0.015	0.997663	0.995128	0.9926	0.990079	0.987563	0.985055
0.020	0.996149	0.99198	0.987828	0.983694	0.979577	0.975477

0.025	0.993658	0.98681	0.980009	0.973256	0.966548	0.959887
0.030	0.989563	0.978343	0.967249	0.956282	0.945439	0.934718
0.035	0.982846	0.964534	0.946564	0.928928	0.911621	0.894636
0.040	0.971862	0.942175	0.913395	0.885494	0.858445	0.832223
0.045	0.953998	0.906392	0.861162	0.818189	0.77736	0.738569
0.050	0.925197	0.850222	0.781322	0.718006	0.659821	0.606351
0.055	0.879441	0.764825	0.665147	0.578459	0.50307	0.437505
P			**C=2**			
0.010	0.998705	0.997165	0.995383	0.994093	0.992561	0.991031
0.015	0.997866	0.995331	0.992802	0.99028	0.987764	0.985255
0.020	0.996483	0.992313	0.98816	0.984024	0.979906	0.975805
0.025	0.994208	0.987356	0.980552	0.973794	0.967083	0.960418
0.030	0.990467	0.979236	0.968132	0.957155	0.946302	0.935571
0.035	0.984326	0.965987	0.947989	0.930327	0.912994	0.895983
0.040	0.974277	0.944517	0.915665	0.887694	0.860578	0.834291
0.045	0.957912	0.910111	0.864696	0.821546	0.78055	0.7416
0.050	0.931473	0.855989	0.786623	0.722877	0.664297	0.610465
0.055	0.889321	0.773417	0.672619	0.584958	0.508721	0.44242

0	**1m**	**2m**	**3m**	**4m**	**5m**	**6m**
P			**C=3**			
0.010	0.998828	0.997288	0.995751	0.994216	0.992684	0.991153
0.015	0.998069	0.995533	0.993004	0.990482	0.987965	0.985456
0.020	0.996818	0.992646	0.988491	0.984354	0.980235	0.976132
0.025	0.994758	0.987903	0.981094	0.974333	0.967618	0.96095
0.030	0.991371	0.98013	0.969016	0.958028	0.947165	0.936425
0.035	0.985808	0.967441	0.949417	0.931728	0.914368	0.897332
0.040	0.976698	0.946864	0.91794	0.8899	0.862717	0.836364
0.045	0.961843	0.913846	0.868244	0.824918	0.783753	0.744643
0.050	0.937792	0.861796	0.791959	0.727781	0.668804	0.614606
0.055	0.899311	0.782106	0.680175	0.591529	0.514436	0.44739
P			**C=4**			
0.010	0.998952	0.997412	0.995874	0.994339	0.992806	0.991276
0.015	0.998272	0.995736	0.993206	0.990683	0.988166	0.985656
0.020	0.997152	0.992979	0.988823	0.984685	0.980564	0.97646
0.025	0.995309	0.988449	0.981637	0.974872	0.968154	0.961482
0.030	0.992275	0.981024	0.9699	0.958903	0.94803	0.93728
0.035	0.987293	0.968898	0.950846	0.93313	0.915745	0.898683
0.040	0.979125	0.949216	0.920221	0.892112	0.864861	0.838442
0.045	0.96579	0.917596	0.871807	0.828303	0.786969	0.747699
0.050	0.944154	0.867642	0.797331	0.732718	0.673341	0.618775
0.055	0.909414	0.790892	0.687816	0.598174	0.520215	0.452416
P			**C=5**			
0.010	0.999075	0.997535	0.995997	0.994462	0.992929	0.991398
0.015	0.998475	0.995938	0.993408	0.990885	0.988368	0.985857
0.020	0.997487	0.993312	0.989155	0.985015	0.980893	0.976787
0.025	0.995859	0.988996	0.98218	0.975412	0.96869	0.962014
0.030	0.993181	0.981919	0.970786	0.959778	0.948895	0.938136
0.035	0.988779	0.970357	0.952278	0.934535	0.917124	0.900037
0.040	0.981558	0.951575	0.922508	0.894328	0.86701	0.840525
0.045	0.969753	0.921361	0.875384	0.831702	0.790199	0.750767
0.050	0.950558	0.873528	0.80274	0.737688	0.677908	0.622973
0.055	0.91963	0.799776	0.695543	0.604894	0.526059	0.457499
P			**C=6**			
0.010	0.999198	0.997658	0.99612	0.994584	0.993051	0.99152
0.015	0.998678	0.996141	0.993611	0.991086	0.988569	0.986057
0.020	0.997822	0.993645	0.989487	0.985346	0.981222	0.977115
0.025	0.99641	0.989544	0.982724	0.975951	0.969226	0.962546
0.030	0.994088	0.982816	0.971672	0.960654	0.949761	0.938992
0.035	0.990268	0.971818	0.953712	0.935943	0.918505	0.901392
0.040	0.983998	0.95394	0.9248	0.896551	0.869164	0.842614
0.045	0.973733	0.925142	0.878977	0.835115	0.793441	0.753848
0.050	0.957007	0.879454	0.808186	0.742693	0.682507	0.627199
0.055	0.929961	0.808761	0.703356	0.611689	0.531969	0.462638

The following figure-1 shows the OC Curve for the acceptance number c=0, s=20, m=50, r= 1, 2, 3, 4, 5, 6 and sample size n=50, 100, 150, 200, 250 and 300.

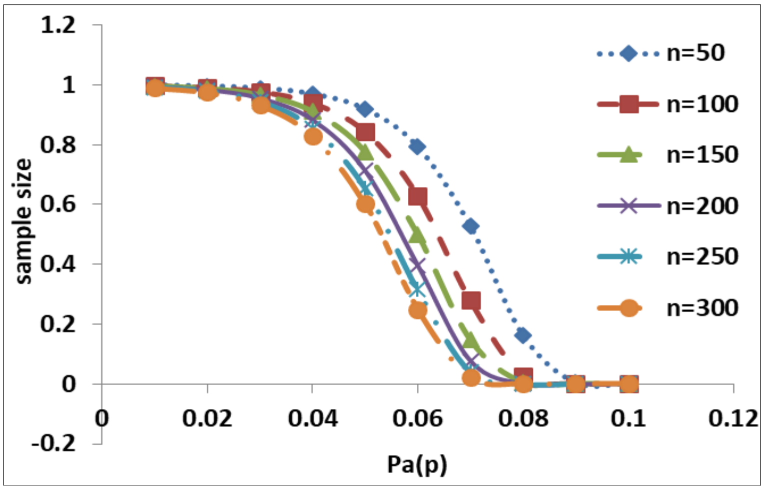

Fig 1: OC Curve for Laplace Distribution using QRSS

It shows the impact of expanded example size on OC bend. We note that each plan utilizes the equivalent percent blemished which can be considered an acknowledgment part, the OC bend becomes more extreme and lies nearer to the beginning as the example size increments.

Average Sample Number (ASN)

She Average Sample Number (ASN) is portrayed as the typical (expected) number of test units per lot, as most would consider to be normal to appear at a decision about the affirmation or excusal of the part under the affirmation examining plan. The bend drawn between the ASN and the lot quality (p) is known as the ASN bend.

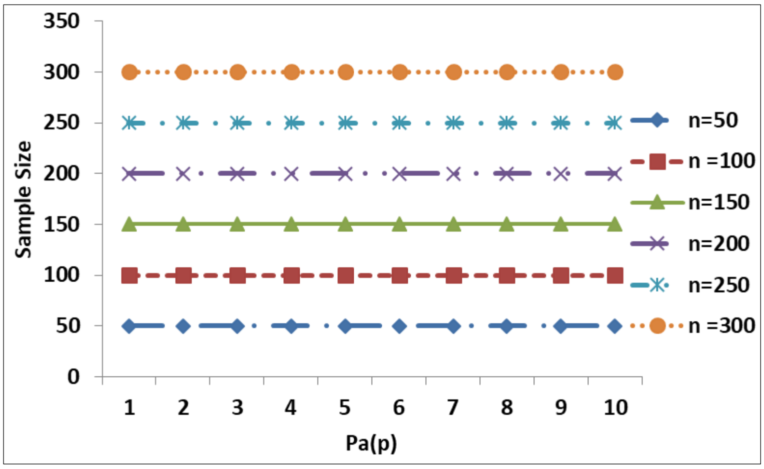

Fig 2: ASN Curve for Laplace Distribution using QRSS

In this research, ASN values (n= 50, 100, 150, 200, 250 and 300) of single sampling plan under Laplace distribution are same.

Average Outgoing Quality (AOQ)

A normal methodology, while examining and testing is non-sad, is to 100 percent survey excused lots and overrides all defectives with extraordinary units. For this present circumstance, all excused parts are made wonderful and the fundamental deformations left are those in parcels that were acknowledged. AOQ's suggest the somewhat long defect level for this united LASP (lot acknowledgment inspecting plan) and 100 percent assessment of excused parts process. If all parts come in with a distortion level of exactly p, and the OC bend for the picked (n, c) LASP exhibits a likelihood Dad of enduring such a ton, from now onward, indefinitely a truly lengthy time span the AOQ can without a doubt be shown to be:

$$AOQ = \frac{Pa(p)(N-n)}{N} \tag{8}$$

Where N is the lot size have given expressions for AOQ to different policies adopted for single sampling attribute plans. In this research, AOQ is approximated as p * Pa (p).

The given table shows the AOQ values for QRSS using Laplace distribution for N=1000, m= 50, s=20, r= 1, 2, 3, 4, 5, 6 and n=50, 100, 150, 200, 250 and 300.

Table 2: The AOQ Values for Laplace Distribution using QRSS

N	1m	2m	3m	4m	5m	6m
P	C=0					
0.010	0.948536	0.897227	0.846075	0.795079	0.744237	0.69355
0.015	0.947587	0.895433	0.843538	0.791902	0.740522	0.689398
0.020	0.946024	0.892482	0.839372	0.786691	0.734436	0.682605
0.025	0.943453	0.887638	0.832547	0.778174	0.72451	0.671549

0.030	0.939228	0.879706	0.821412	0.764328	0.708432	0.653706
0.035	0.9323	0.866776	0.80337	0.742025	0.682688	0.625304
0.040	0.920981	0.845856	0.774461	0.706639	0.642238	0.581112
0.045	0.902594	0.812419	0.728996	0.651876	0.580637	0.514885
0.050	0.873015	0.760044	0.659649	0.570535	0.491532	0.421586
0.055	0.826188	0.680696	0.559094	0.457627	0.373111	0.302852
P	**C=1**					
0.010	0.948653	0.897338	0.84618	0.795177	0.744329	0.693636
0.015	0.947779	0.895615	0.84371	0.792063	0.740673	0.689538
0.020	0.946342	0.892782	0.839654	0.786955	0.734683	0.68283]4
0.025	0.943975	0.888129	0.833008	0.778604	0.724911	0.671921
0.030	0.940085	0.880509	0.822162	0.765025	0.709079	0.654303
0.035	0.933704	0.868081	0.804579	0.743142	0.683716	0.626245
0.040	0.923269	0.847958	0.776386	0.708395	0.643834	0.582556
0.045	0.906298	0.815753	0.731988	0.654551	0.58302	0.516998
0.050	0.878937	0.7652	0.664124	0.574405	0.494866	0.424446
0.055	0.835469	0.688343	0.565375	0.462768	0.377302	0.306254
P	**C=2**					
0.010	0.94877	0.897449	0.846075	0.795275	0.744421	0.693722
0.015	0.947972	0.895798	0.843882	0.792224	0.740823	0.689679
0.020	0.946659	0.893081	0.839936	0.787219	0.734929	0.683063
0.025	0.944497	0.888621	0.833469	0.779035	0.725312	0.672293
0.030	0.940943	0.881312	0.822912	0.765724	0.709726	0.6549
0.035	0.93511	0.869388	0.805791	0.744261	0.684745	0.627188
0.040	0.925564	0.850065	0.778315	0.710155	0.645434	0.584003
0.045	0.910017	0.8191	0.734991	0.657237	0.585413	0.51912
0.050	0.8849	0.77039	0.668629	0.578302	0.498223	0.427325
0.055	0.844855	0.696075	0.571726	0.467966	0.381541	0.309694

N	**1m**	**2m**	**3m**	**4m**	**5m**	**6m**
P	**C=3**					
0.010	0.948887	0.89756	0.846388	0.795373	0.744513	0.693807
0.015	0.948165	0.89598	0.844054	0.792385	0.740974	0.689819
0.020	0.946977	0.893381	0.840218	0.787483	0.735176	0.683292
0.025	0.94502	0.889112	0.83393	0.779466	0.725714	0.672665
0.030	0.941802	0.882117	0.823663	0.766423	0.710374	0.655498
0.035	0.936518	0.870697	0.807004	0.745382	0.685776	0.628133
0.040	0.927863	0.852177	0.780249	0.71192	0.647038	0.585455
0.045	0.913751	0.822461	0.738007	0.659934	0.587815	0.52125
0.050	0.890902	0.775617	0.673165	0.582225	0.501603	0.430224
0.055	0.854346	0.703895	0.578149	0.473223	0.385827	0.313173
P	**C=4**					
0.010	0.949004	0.89767	0.846493	0.795471	0.744605	0.693893
0.015	0.948358	0.896162	0.844225	0.792547	0.741125	0.689959
0.020	0.947295	0.893681	0.8405	0.787748	0.735423	0.683522
0.025	0.945543	0.889604	0.834392	0.779898	0.726115	0.673037
0.030	0.942662	0.882922	0.824415	0.767122	0.711022	0.656096
0.035	0.937928	0.872008	0.808219	0.746504	0.686809	0.629078
0.040	0.930169	0.854295	0.782188	0.713689	0.648645	0.586909
0.045	0.917501	0.825836	0.741036	0.662642	0.590227	0.523389
0.050	0.896946	0.780878	0.677732	0.586174	0.505006	0.433143
0.055	0.863943	0.711802	0.584644	0.478539	0.390161	0.316691
P	**C=5**					
0.010	0.949121	0.897781	0.846597	0.795569	0.744696	0.693979
0.015	0.948551	0.896345	0.844397	0.792708	0.741276	0.6901
0.020	0.947612	0.893981	0.840782	0.788012	0.735669	0.683751
0.025	0.946066	0.890097	0.834853	0.780329	0.726517	0.67341
0.030	0.943522	0.883728	0.825168	0.767822	0.711671	0.656695
0.035	0.93934	0.873321	0.809436	0.747628	0.687843	0.630026
0.040	0.932481	0.856418	0.784132	0.715463	0.650257	0.588368
0.045	0.921266	0.829225	0.744077	0.665361	0.592649	0.525537
0.050	0.903031	0.786175	0.682329	0.590151	0.508431	0.436081
0.055	0.873649	0.719799	0.591211	0.483915	0.394544	0.320249
P	**C=6**					
0.010	0.949238	0.897892	0.846702	0.795667	0.744788	0.694064
0.015	0.948744	0.896527	0.844569	0.792869	0.741427	0.69024
0.020	0.94793	0.894281	0.841064	0.788276	0.735916	0.683981
0.025	0.94659	0.890589	0.835315	0.780761	0.726919	0.673782
0.030	0.944383	0.884534	0.825921	0.768523	0.712321	0.657294

0.035	0.940755	0.874636	0.810655	0.748754	0.688879	0.630974
0.040	0.934798	0.858546	0.78608	0.717241	0.651873	0.58983
0.045	0.925046	0.832628	0.74713	0.668092	0.595081	0.527693
0.050	0.909156	0.791508	0.686958	0.594154	0.51188	0.439039
0.055	0.883463	0.727885	0.597853	0.489351	0.398977	0.323847

The following figure-3 shows the AOQ Curve for the acceptance number c=0, s=20, m=50, r= 1, 2, 3, 4, 5, 6 and sample size n=50, 100, 150, 200, 250 and 300.

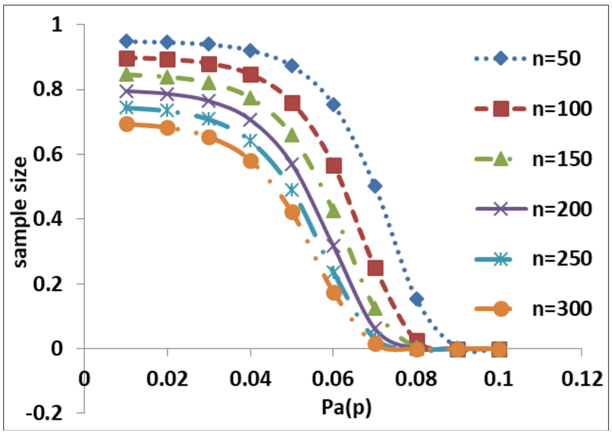

Fig 3: AOQ Curve for Laplace Distribution using QRSS

For the acceptance sampling plan in which correction isn't finished, the AOQ is equivalent to the approaching quality. Hence when the part is either acknowledged or dismissed, the AOQ is equivalent to the nature of the submitted lot.

Average Total Inspection (ATI)

At the point when dismissed lots are 100 per cent investigated, it is not difficult to work out the ATI if lots come reliably with a deformity level of ' p'. For a LASP (n, c) with a probability Pa of tolerating a lot with deformity level p, one can have

$$ATI=n+ (1-Pa) (N-n) \quad (9)$$

Where N is the lot size, n is the sample size.

Table 3 shows the ATI values for QRSS using Laplace distribution for N=1000, m=50, s=20, r= 1, 2, 3, 4, 5, 6 and n=50,100,150, 200, 250 and 300.

Table 3: The ATI Values for Laplace Distribution using QRSS

n	1m	2m	3m	4m	5m	6m
P			**C=0**			
0.010	51.46445	102.7726	153.9248	204.9215	255.7629	306.4495
0.015	52.41336	104.5669	156.4615	208.0983	259.4782	310.6021
0.020	53.97594	107.5176	160.6277	213.3088	265.5637	317.395
0.025	56.54703	112.3622	167.4528	221.8262	275.4898	328.4506
0.030	60.772	120.2944	178.5877	235.6721	291.5676	346.2938
0.035	67.69981	133.2241	196.6303	257.9748	317.3123	374.6962
0.040	79.01927	154.1441	225.5387	293.3608	357.7621	418.8882
0.045	97.40615	187.5811	271.0039	348.1239	419.3625	485.1145
0.050	126.9851	239.9562	340.3508	429.4651	508.4683	578.4139
0.055	173.8119	319.3041	440.9059	542.3734	626.8891	697.1483
P			**C=1**			
0.010	51.34738	102.6619	153.8204	204.8234	255.6711	306.3639
0.015	52.22052	104.3846	156.2899	207.9371	259.3274	310.4618
0.020	53.65848	107.2181	160.346	213.0448	265.3172	317.1659
0.025	56.02493	111.8709	166.9921	221.3956	275.0888	328.079
0.030	59.91475	119.4915	177.838	234.9745	290.921	345.6972
0.035	66.29604	131.919	195.4207	256.8575	316.2843	373.7547
0.040	76.73071	152.0422	223.6142	291.6048	356.1661	417.4442
0.045	93.70232	184.2473	268.0124	345.4489	416.9798	483.0017
0.050	121.0629	234.8004	335.8759	425.5948	505.134	575.554
0.055	164.5307	311.6573	434.6252	537.2325	622.6977	693.7462
P			**C=2**			
0.010	51.23029	102.5511	153.9248	204.7252	255.5792	306.2783
0.015	52.02764	104.2024	156.1182	207.7759	259.1767	310.3214
0.020	53.34091	106.9185	160.0642	212.7807	265.0707	316.9368
0.025	55.50255	111.3795	166.5311	220.9647	274.6877	327.7072
0.030	59.05673	118.6878	177.0876	234.2763	290.2739	345.1
0.035	64.89016	130.6119	194.2092	255.7386	315.2549	372.8118
0.040	74.43647	149.9351	221.6849	289.8445	354.5663	415.9966
0.045	89.98329	180.8998	265.0087	342.7629	414.5874	480.8802
0.050	115.1005	229.6095	331.3707	421.6983	501.777	572.6747
0.055	155.1452	303.9246	428.2739	532.0339	618.4592	690.3058

N	1m	2m	3m	4m	5m	6m
P			**C=3**			
0.010	51.11319	102.4404	153.6115	204.6271	255.4873	306.1927
0.015	51.83471	104.0201	155.9464	207.6147	259.0259	310.1811

0.020	53.02324	106.6188	159.7824	212.5166	264.8241	316.7075
0.025	54.97987	110.8877	166.0698	220.5336	274.2863	327.3351
0.030	58.19791	117.8834	176.3365	233.5774	289.6261	344.5022
0.035	63.48217	129.3029	192.996	254.6179	314.2239	371.8674
0.040	72.13652	147.8228	219.7509	288.0799	352.9624	414.5454
0.045	86.249	177.5386	261.9926	340.0659	412.1851	478.7499
0.050	109.0976	224.3834	326.835	417.7753	498.3972	569.7758
0.055	145.6543	296.105	421.8512	526.7768	614.173	686.8267
P			**C=4**			
0.010	50.99607	102.3296	153.5071	204.5289	255.3954	306.107
0.015	51.64175	103.8377	155.7746	207.4535	258.8752	310.0407
0.020	52.70546	106.319	159.5004	212.2523	264.5774	316.4782
0.025	54.4569	110.3957	165.6083	220.1023	273.8847	326.9629
0.030	57.33832	117.0783	175.5847	232.8779	288.9777	343.904
0.035	62.07205	127.9918	191.7809	253.4956	313.1913	370.9216
0.040	69.83087	145.7052	217.812	286.3108	351.3546	413.0906
0.045	82.49938	174.1636	258.9642	337.3579	409.773	476.611
0.050	103.054	219.1219	322.2685	413.8257	494.9945	566.8573
0.055	136.0567	288.1976	415.3564	521.4607	609.8387	683.3086
P			**C=5**			
0.010	50.87894	102.2188	153.4026	204.4307	255.3035	306.0214
0.015	51.44875	103.6554	155.6028	207.2922	258.7243	309.9003
0.020	52.38757	106.0191	159.2184	211.988	264.3306	316.2489
0.025	53.93365	109.9034	165.1466	219.6707	273.4829	326.5904
0.030	56.47794	116.2725	174.8323	232.1777	288.3288	343.3051
0.035	60.65981	126.6789	190.5639	252.3716	312.1571	369.9744
0.040	67.51948	143.5823	215.8684	284.5373	349.7428	411.6322
0.045	78.73438	170.7747	255.9233	334.6387	407.351	474.4632
0.050	96.96947	213.8247	317.671	409.8493	491.5687	563.9191
0.055	126.3514	280.2014	408.7886	516.0849	605.4557	679.7509
P			**C=6**			
0.010	50.7618	102.108	153.2981	204.3325	255.2116	305.9358
0.015	51.25571	103.4729	155.431	207.1308	258.5735	309.7598
0.020	52.06957	105.7191	158.9362	211.7235	264.0837	316.0194
0.025	53.41011	109.4108	164.6846	219.2388	273.0808	326.2178
0.030	55.61677	115.4659	174.0791	231.4769	287.6792	342.7058
0.035	59.24544	125.3639	189.3451	251.2459	311.1215	369.0258
0.040	65.20235	141.4542	213.9199	282.7595	348.1269	410.1701
0.045	74.95393	167.372	252.8699	331.9084	404.919	472.3067
0.050	90.84362	208.4916	313.0423	405.8459	488.1197	560.9608
0.055	116.537	272.1153	402.1471	510.6487	601.0235	676.1533

The following figure-4 shows the ATI Curve for the acceptance number c=0, s=20, m=50, r= 1, 2, 3, 4, 5, 6 and sample size n=50, 100, 150, 200, 250 and 300.

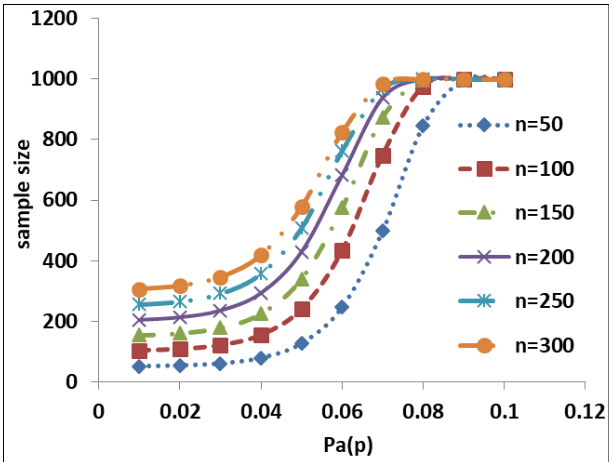

Fig 4: ATI Curve for Laplace Distribution using QRSS

The curve drawn between ATI and the lot quality (p) is known as ATI curve. A typical ATI curve for a single sample plan is shown for N= 1000, n= 50,100, 150, 200, 250 and 300.

Illustration

A manufacturer of laptop bags produces laptop bags in lots (N) of 1000 by using QRSS method, distributed by Laplace distribution. Then, the scale parameter (s) is 20, sample set size (m) is 50 and the cycle size (r) is 3. The quality of incoming lot is 0.040 and the acceptance numbers are 0 and 1.

Explanation

It is given, sample size of bags m =50 and sample cycle size r = 3 (specified by the producer). Hence, n= m*r (150 = 50*3). For a fixed lot quality p = 0.040, the value of the parameter (s) is 20. Then $[m,r]_{ij}$ is the $(m,r)^{th}$ judgment order statistics of the i^{th} random sample of size m in the j^{th} cycle. In a sample of n=150 specimens selected from a lot of laptop bags manufacturing company, if X≤c, the lot is accepted, otherwise reject the lot and inform the management for further action. If X represents the number of defective laptop bags in the sample, if X=0 the probability of accepting the lot Pa(p) is 0.91113, ASN is 150, AOQ is 0.774461, ATI is 226 (225.5 is equivalent to 226). If X=1 the probability of accepting the lot Pa (p) is 0.913395, ASN is 150, AOQ is 0.776386, ATI is 224.

Conclusion

In this study, QRSS procedure is considered for Construction of Acceptance Sampling Plans by Quartile Ranked Set

Sampling using Laplace Distribution. The QRSS is compared with RSS and SRS in estimating the distribution function. It is found that QRSS is more efficient than SRS and also it is more efficient than RSS in most cases considered in this study.

In this paper, another QRSS technique is recommended for considering Operating Characteristic Curve, Average Sample Number, Average Outgoing Quality and Average Total Inspection. It is more effective than basic arbitrary testing on the grounds that fewer samples should be gathered and estimated.

This study can be extended further for the various parameters such as AQL, LQL, IQL, AOQL, MAPD and MAAOQL. Further it can be extended to Double Sampling Plan, Multi-stage Sampling Plan, other Special Purpose Plans as Chain Sampling, Skip Plot Sampling Plans as well.

Reference

1. Muttlak HA. Investigating the use of quartile ranked set samples for estimating the population mean, Journal of Applied Mathematics and Computation. 2003;146:437-443.
2. Adatia A, Saleh AK. Md. Estimation of quantiles of uniform distribution using generalized ranked set sampling. Pakistan Journal of Statistics. 2004;20:355-368.
3. Chen Z. On ranked-set sample quantiles and their applications. Journal of Statistical Planning and Inference. 2000;83:125-135.
4. Jemain AA, AL-Omari AI. Double quartile ranked set samples. Pakistan Journal of Statistics. 2006b;22:217-228.
5. Jemain AA, AL-Omari AI. Multistage quartile ranked set samples. Pakistan Journal of Statistics. 2007b;23:11-22.
6. Zhu M, Wang Y. Quantile estimation from ranked set sampling data. Sankhya: The Indian Journal of Statistics. 2004;67:295-304.
7. McIntyre GA. A method for unbiased selective sampling, using ranked sets. Australian journal of agricultural research. 1952;3(4):385-90.
8. Takahasi K, Wakimoto K. On unbiased estimates of the population mean based on the sample stratified by means of ordering. Annals of the institute of statistical mathematics. 1968 Dec 1;20(1):1-31.
9. Sinha MK, Opentanova I, Ohannesian JP, Kolaczynski JW, Heiman ML, Hale J, *et al*. Evidence of free and bound leptin in human circulation. Studies in lean and obese subjects and during short-term fasting. The Journal of clinical investigation. 1996 Sep 15;98(6):1277-82.