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BALANCED α AND β RISKS TABLES
(SINGLE SAMPLING)

Document prepared by experts from Spain

INTRODUCTION

TWC has got many of its conclusions in autogamous homogeneity item with tables TWC/11/16 .This is a good document and represents one of the approaches to the problem. With parameters such as population standard p, and acceptance probability P, in tables one can get the k, maximum number of off-types tolerable in a sample of size n. Nevertheless, some problems arise when it is tried to extend those tables to every crop. Some of them may be the following:

1. These tables suppose that p, population standard is perfectly known. That may be the case of some important crops for which are legal requirements. But in case of not being fixed the population standard (case of many crops which are waiting for guidelines) it is necessary to assume it. The consequence of adopting a population standard without at least have done some estimation for it ,may lead to important errors.

2. With these tables we get

(a) p errors small
(b) 2p errors ,(consumer risk) very large
(c) Acceptance probabilities are merely indicated (but taking 99 or 95% may increase the β risks.β2P)

The reason for these large β2p is that only αp are considered to reach P Acceptance probability.

That β2p is the probability of accepting a sample in spite of being a sample with double percent of off-types than the population standard fixed) .

As the case should be that for those new crops we do not know very well the population standard, the errors may be important

3. It doesn’t seem anyway to be one of the objectives of UPOV to look for population standards for every crop. When doing so, it will be risky to write these population standards in future guidelines. It is good to remember that the method is what is forcing to choose those population standards, that in best of cases population standards got may be very different than those required by other authorities like certification ones.

One interesting task of TWC seems to be to look for applicable methods that permit to the techniques to work with a crop in DUS trials. But at fixing a parameter like p, population standard imposes a crop to be of a certain way and that doesn't seem to be the way

4. It is rather strange that we try autogamous species in other way than we have done with alogams .Why is that difference? Methods in alogams of course are more difficult but why not treating autogams with the same philosophy?. At first, homogeneity is a term for autogams not very usual in my country when we speak of off-types. We speak of uniformity. Homogeneity holds another things, like the continuous variation in the characters.

The main philosophy in alogams has been that a candidate variety has not to be very different than the established varieties. COYU has been an improvement for some “special” varieties that with old method might be not included in list now. Of course, the right technique of those varieties to be accepted was clear. Autogamous and pure lines should answer to hypothesis parallel than those thrown in autogams.

LOOKING FOR ESTIMATORS OF POPULATION STANDARD

What is sure is that we need a population standard but we may deduce it from countings in the reference collection. Estimation of p will be more precise as we have looked in many plants of a crop or a type within a crop. This philosophy has been followed in TWC/13/9 though this method is different. If we have seen in our reference collection that estimation of p is 1.5%, if we look in Tables TWC/11/16 we see that maximum number of off-types allowed in a sample of (three years) 35 x 3 =105 with an acceptance probability of 99,95 is 7 with a error $\alpha p = 0,02$ and an error $\beta 2p = 98,6$ and a $\beta 5p= 46,57$ that seems a little large. Is not possible to reduce that error $\beta 5p$?. To try to reduce it is necessary to introduce concept of OC curves, related with sampling plans

OC (OPERATING CHARACTERISTIC) CURVES:

The OC function is the mathematical expression stating the probability of accepting a variety as a function of the fraction of off-types p (population standard) in a variety.

A good graphic representation of the OC curve can be obtained from as few as five points. We know that when $p=0,\beta=1$ and when $p=1,\beta=0$. If we have another values of b and p we should therefore plot the values of b for these five values of p to obtain an approximation to an OC curve.

That should be one way of describing a concrete sampling plan and should be its OC curve.

If we assume then that for example with p estimation =1.5% the following risks may be desired

$P1=.015 \qquad \alpha 1=.05$

A)

$P2=.05 \qquad \beta 2=.01$

we see in Table 1 that with p=1.5% some sampling plans that should be the best to reduce $\beta 2$

(110,4,5)
(150,5,6)
(225,8,9)
(300,10,11)
(450,14,15)

(110,4,5) means that with a sample of 110 we accept with 4 off-types and reject with 5.

(300,10,11) means that with a sample of 300 we accept 10 and reject 11 and so on

METHOD USED TO GET OC CURVES

Results are shown in Table 1

To get those tables we have to look with p estimated and n the first number k that has small α 1 and β2 to fit A

α1 is computed in figure with Poisson distribution, since the sample size is large, though small compared with lot size, and the fractions of off-types in which we are interested are small. When P1=.015 and n=300, nP=4.5, and Pr(k>11)=.0062. When P=.05, then nP=15 and Pr(k<=10)=.1186. So we have

P1=.015 α1=.0062

P2=.05 β2=.1186

A comparison for three sampling plans should be as follows:

	α1 p1=.015	β2 p2=.05
(225,8,9)	0,0079	0,21
(300,10,11)	0,0062	0,1186
(450,14,15)	0,0641	0,386

As sample size increases the maximum steepness of the OC curve becomes greater, mainly because β2 becomes smaller. So we have assured for a good protection such as A , the better number of off-types with the minimum β2, Table 1 shows different sampling plans where one can choose for different sample sizes and ps.

Anyway if we have another sample size one can build another sampling plan as (1500,35,36) or choose a sampling plan near them as can be (1498,34,35) or others.

With other population standards and with A we can get as we have done with Table 1 the Tables 38.4A that are a part of master tables used for normal inspection and are used in industry for single sampling.(Those are tables got from Military Standard 105A: Sampling Procedures and Tables for Inspection by Attributes)

TABLE 1

OC CURVES

P1 (MINIMUM)	**1.5 %**
α1	**<=5**
β2	**<=40**
P2 (MAXIMUM)	**10%**

n	K	α1	β2
Sample Size	**Maximum Number of off-types**		
84	3	3,921	39,540
85	3	4,064	38,621
86	3	4,210	37,715
87	3	4,360	36,823
88	3	4,512	35,945
89	3	4,667	35,080
90	3	4,825	34,230
91	3	4,986	33,393
105	4	2,233	39,777
106	4	2,314	38,952
107	4	2,396	38,136
108	4	2,480	37,331
109	4	2,566	36,536
110	4	2,654	35,752
111	4	2.744	34.970
112	4	2,836	34,215
113	4	2,930	33,463
148	5	2,587	25,256
149	5	2,661	24,695
150	5	2.737	24,144
150	6	0,837	37,815
151	5	2,813	23,600
152	5	2,891	23,068
224	8	0,772	21,471

	225	7	2,222	12,777
	225	8	0,793	21,054
	226	8	0.815	20.643
	227	8	0,837	20,238
	297	10	0,621	12,594
	298	10	0,636	12,341
	299	10	0,651	12,092
	300	8	4,026	3,745
	300	9	1,709	6,985
	300	10	0,667	11,846
	300	11	0,240	18,475
	301	10	0,683	11,605
	302	10	0,699	11,368
	448	14	0,399	4,029
	449	14	0,407	3,944
	450	11	4,285	0,583
	450	12	2,098	1,177
	450	13	0,963	2,206
	450	14	0,415	3,860
	451	14	0.424	3.778
	746	20	0,562	0,144
	747	20	0,570	0,141
	748	20	0,578	0,137
	749	20	0,587	0,134
	750	17	3,854	0,015
	750	18	2,161	0,032
	750	19	1,159	0,066
	750	20	0,595	0,131
	750	21	0,293	0,246
	751	20	0,604	0,128
	1496	35	0,506	0,000
	1497	35	0,511	0,000
	1498	35	0,516	0,000
	1500	31	3,427	0,000
	1500	32	2,230	0,000
	1500	33	1,414	0,000
	1500	34	0,874	0,000
	1500	35	0,527	0,000
	1500	36	0,310	0,000

TABLE 38.4A MASTER TABLE FOR NORMAL INSPECTION (SINGLE SAMPLING)

SAMPLE SIZE	Acceptable Quality Levels (normal inspection)												
	0.015	0.035	0.065	0.10	0.013	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5
	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE
2													
3													0 1
5												0 1	
7											0 1		
10										0 1			1 2
15									0 1			1 3	2 3
25								0 1			1 2	2 3	3 4
35							0 1			1 2	2 3	3 4	5 6
50						0 1			1 2	2 3	3 4	4 5	6 7
75					0 1			1 2	2 3	3 4	4 5	6 7	9 10
110				0 1			1 2	2 3	3 4	4 5	6 7	8 9	12 13
150			0 1			1 2	2 3	3 4	4 5	5 6	8 9	11 12	17 18
225		0 1			1 2	2 3	3 4	4 5	5 6	8 9	11 12	17 18	24 25
300	0 1			1 2	2 3	3 4	4 5	5 6	7 8	10 11	14 15	20 21	32 33
450			1 2	2 3	3 4	4 5	5 6	7 8	10 11	14 15	20 21	29 30	43 44
750		1 2	2 3	3 4	4 5	6 7	8 9	11 12	15 16	20 21	31 32	45 46	68 69
1500	1 2	2 3	3 4	5 6	7 8	9 10	13 14	18 19	15 26	35 36	56 57	81 82	124 126

= Use first sampling plan below arrow. AC = Acceptance number. RE = Rejection number

TABLE 38.4A MASTER TABLE FOR NORMAL INSPECTION (SINGLE SAMPLING)

SAMPLE SIZE	Acceptable Quality Levels (normal inspection)										
	10.0	15.0	25.0	40.0	65.0	100.0	150.0	250.0	400.0	650.0	1000.0
	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE	AC RE
2	0 1			1 2	2 3	3 4	5 6	8 9	12 13	19 20	18 29
3			1 2	2 3	3 4	5 6	8 9	12 13	18 19	28 29	41 42
5		1 2	2 3	3 4	5 6	8 9	12 13	19 20	29 30	44 45	65 66
7	1 2	2 3	3 4	5 6	7 8	11 12	17 18	26 27	39 40	60 61	89 90
10	2 3	3 4	5 6	7 8	10 11	15 16	23 24	36 37	54 55	83 84	123
15	3 4	4 5	7 8	10 11	15 16	22 23	33 34	51 52	78 79	121 122	124
											178
											179
25	5 6	7 8	11 12	16 17	24 25	35 36	51 52	80 81	124 125	192 193	
35	7 8	10 11	15 16	22 23	33 34	48 49	69 70	110 111	168 169		
50	9 10	13 14	20 21	30 31	46 47	67 68	96 97	151 152			
75	13 14	19 20	29 30	43 44	66 67	96 97	138 139				
110	18 19	26 27	40 41	60 61	93 94	135 136					
150	24 25	34 35	53 54	80 81	123 124						
225	34 35	48 49	76 77	115 116							
300	44 45	63 64	98 99								
450	62 63	89 90									
750	98 99										
1500	184 185										

= Use first sampling plan below arrow. AC = Acceptance number. RE = Rejection number

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