What Sets the Protection Is How Many Are Drawn, Not What Fraction of the Lot

— drawing the same 50, lots of 1000 and 10000 differ in acceptance probability by at most $\mathbf{0.006982}$, while drawing “five per cent” tightens a lot with defect rate 0.05 by a factor of $\mathbf{607.4509}$ — [Paper 552]

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— *From thinking to syncing.* —

Abstract

Acceptance sampling is usually framed as a question of what fraction of a lot to inspect.What this paper shows is that the protection is set by the number drawn rather than the fraction, and that deciding by fraction turns the size of the lot into a level of protection.No new theorem or law is claimed. First, and this is the core.A tenfold lot barely moves the acceptance probability——across four defect rates the difference is at most $\mathbf{0.006982}$ (Section 2). **Second, the inspected fraction meanwhile differs exactly tenfold——5.0 per cent against 0.5 per cent, to 12 digits** (Section 2). **Third, the larger lot sits closer to the limit——$N = 10000$ agrees with the infinite-lot limit to within 0.002** (Section 2). **Fourth, deciding by fraction makes it a different scheme——a five-per-cent draw is $\mathbf{607.4509}$ times stricter on the same lot** (Section 3). **Fifth, it is the shape of Paper 383——as an insurance loading is set by the number of policies, protection is set by the size of the sample and not of the population** (Section 4). **Sixth, the separator is whether the sample is small against the lot——draw half of it and the lot size begins to matter** (Section 4). **Keywords**: acceptance sampling, OC curve, hypergeometric distribution, lot size, quality assurance.

Scope of this paper (scope note): **No new theorem or law is claimed——the hypergeometric distribution, its binomial limit and the operating characteristic curve are standard.No sampling scheme is recommended——which n and c to choose is not stated; only what changes when the choice changes.Inspection costs are not discussed——neither the cost per unit inspected nor the cost of a defect passed is included.Destructive and non-destructive inspection are not distinguished——losing the drawn units is not counted.Continuous and adjustable sampling are excluded——only a single look at a single lot is treated.It is not said that sampling by fraction is wrong——a fraction gives stronger protection; the trouble is that the strength then varies with the size of the lot.Relation to earlier papers**: **Paper 383 showed that what sets an insurance loading is the number of policies rather than the accuracy of the probability ——"protection comes from the sample, not the population" has the same shape and the same root, though that one concerns the size of a loading and this one the shape of an acceptance curve.Paper 317 showed that a significance level is a promise per test——an acceptance probability is likewise a promise about one lot, not about a year of them.Paper 300 showed that sharing a root is decidable——"acceptance does not depend on lot size" and "sampling by fraction tightens" are separate roots.**What is added is **measuring the tenfold-lot difference as $\mathbf{0.006982}$**, **setting beside it the inspected fraction differing by exactly ten to 12 digits**, **confirming independently that $N = 10000$ meets the infinite limit within 0.002**, **obtaining the ratio against fractional sampling as $\mathbf{607.4509}$**, and **placing the separator on whether the sample is small against the lot**.

1. Notation and the Question

Setting: **a lot of N items contains a fraction p defective.Draw n of them and accept the lot if at most c are defective, writing $\mathrm{OC}(p)$ for the probability of acceptance.Because the drawn items are not replaced, the exact law is hypergeometric.**

Observation 1.1

the question on the floor has the shape of a fraction."Full inspection is impossible, so we look at five per cent"——which assumes that the fraction expresses the strength of the protection.

Observation 1.2

N does appear in the formula.The hypergeometric law contains the lot size——so independence is not obvious, and has to be measured.

Question: **how much does the size of the lot change the protection?**

2. A Tenfold Lot Barely Moves It

Computation 2.1: holding $n = 50$ and $c = 1$, varying only the lot size.

defect rate p	$N = 1000$	$N = 10000$	infinite limit
0.01	0.914692	0.910953	0.910565
0.02	0.736043	0.735791	0.735771
0.05	0.271691	0.278673	0.279432
0.10	0.030773	0.033482	0.033786

> **Observation 2.2**
>
> this is the core.A tenfold lot moves the acceptance probability by at most $\mathbf{0.006982}$——above 0.005 and below 0.01; “under one per cent” set beforehand would merely have happened to hold.

> **Observation 2.3**
>
> the larger lot is nearer the limit.$N = 10000$ agrees with the infinite-lot limit, the binomial, to within 0.002——the limit is a formula assembled separately, so this is a check: were the values not to approach it, the hypergeometric implementation would be in doubt.

> **Observation 2.4**
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> both boundaries were examined.A defect rate of 0 always accepts and a defect rate of 1 always rejects, each to 12 digits——either failing would mean the formula is wrong.

Computation 2.5: what the inspected fraction is doing meanwhile.

lot	drawn	inspected fraction
1000	50	**0.0500** (5.0 per cent)
10000	50	**0.0050** (0.5 per cent)
ratio	1	**10.0000**

Observation 2.6

the fraction differs by exactly ten to 12 digits.The protection is nearly the same while the fraction moves tenfold——the fraction does not express the strength of the protection. It expresses the labour of inspecting.

Observation 2.7

the cost per unit falls tenfold.The same protection is bought more cheaply on the larger lot——which is where the gain from consolidating lots lies.

3. Deciding by Fraction Makes It a Different Scheme

Computation 3.1: **drawing five per cent of $N = 10000$, that is $n = 500$, and scaling the allowance to $c = 10$.**

scheme	acceptance at a defect rate of 0.05
$n = 50$, $c = 1$	**0.279432**
$n = 500$, $c = 10$ (five per cent)	**0.000460**
ratio	**607.4509**

Observation 3.2

more than six hundred times stricter.The nominal standard looks identical, allowing two per cent defective, yet the chance of passing differs by orders——scaling the allowance with the fraction does not scale the protection.

Observation 3.3

so sampling by fraction lets the lot size set the protection.The same five per cent means $n = 50$ at $N = 1000$ and $n = 500$ at $N = 10000$——and since the protection follows the latter, larger lots are judged more harshly. Unless that is intended, it is an accident.

Observation 3.4

the misreading of Paper 317 compounds it.An acceptance probability is a promise about one lot——across hundreds of lots a year, the chance of passing none of the bad ones is far lower.

4. The Separator

Observation 4.1

the separator is whether the sample is small against the lot.While n is small beside N, the hypergeometric law is near the binomial——draw half and the lot size begins to matter; draw all of it and acceptance becomes 0 or 1. The independence is not unconditional.

Observation 4.2

it is the shape of Paper 383.There the loading was set by the number of policies——both follow from the single point that precision comes from the size of the sample and not of the population, though that one concerns the size of a loading and this one the shape of a curve.

Observation 4.3

separate roots under Paper 300.“Acceptance does not depend on lot size” carries a small n/N ——“sampling by fraction tightens” carries the curve steepening with n. With the first alone, sampling by fraction would change nothing.

Observation 4.4

what is not said.Sampling by fraction is not called wrong——it gives stronger protection; the trouble is that the strength then varies with the size of the lot.

5. Roll Call and Closing

1. **a tenfold lot moves acceptance by 0.006982** (Computation 2.1): **the core.**
2. **above 0.005 and below 0.01** (Observation 2.2): **measured, then bracketed.**
3. **$N = 10000$ within 0.002 of the limit** (Observation 2.3): **a separately assembled formula.**
4. **0 always accepts, 1 always rejects** (Observation 2.4): **both boundaries.**
5. **fractions 0.0500 against 0.0050** (Computation 2.5): **tenfold, to 12 digits.**
6. **five-per-cent draw accepts at 0.000460** (Computation 3.1): **$n = 500$, $c = 10$.**
7. **a ratio of 607.4509** (Computation 3.1): **a different scheme.**
8. **the separator is a small n/N** (Observation 4.1): **half a lot begins to matter.**
9. **the same side as Paper 383** (Observation 4.2): **precision from the sample.**

Closing: **Acceptance sampling is usually framed as a question of what fraction of a lot to inspect.Yet the protection is set by the number drawn, not by the fraction——drawing 50 and allowing one defective, a lot of 1000 and a lot of 10000 differ in acceptance probability by at most 0.006982 across four defect rates. That lies above 0.005 and below 0.01, and "under one per cent" set beforehand would merely have happened to hold. The value at $N = 10000$ agrees with the infinite-lot limit to within 0.002, and since that limit is a separately assembled formula it serves as a check; a defect rate of 0 always accepting and 1 always rejecting were confirmed at both boundaries.Meanwhile the inspected fraction differs by exactly ten——5.0 per cent against 0.5 per cent, to 12 digits. With the protection nearly unchanged while the fraction moves tenfold, what the fraction expresses is not the strength of the protection but the labour of inspecting. Read the other way, the same protection is bought on the larger lot at a tenth of the cost.And deciding by fraction makes it a different scheme——drawing five per cent of 10000, that is $n = 500$ with $c = 10$, takes the acceptance of a lot five per cent defective from 0.279432 down to 0.000460, a factor of 607.4509. Scaling the allowance with the fraction does not scale the protection. So the same "five per cent" judges larger lots more harshly, which unless intended is an accident. The misreading of Paper 317 compounds it, since an acceptance probability is a promise about one lot and not about hundreds of them a year.The separator is whether the sample is small against the lot——while n is small beside N the hypergeometric law is near the binomial; draw half and the lot size begins to matter, and draw all of it and acceptance becomes 0 or 1. Paper 383 showed a loading set by the number of policies, and both follow from the single point that precision comes from the sample rather than the**

population, though that one concerns a size and this one the shape of a curve. Under Paper 300, "acceptance does not depend on lot size" carries a small n/N while "sampling by fraction tightens" carries the curve steepening with n.To be honest——no sampling scheme is recommended; which n and c to choose was not stated, only what changes when the choice changes. Inspection costs and the cost of a defect passed were left out, destructive and non-destructive inspection were not distinguished, and only a single look at a single lot was treated. Nor is sampling by fraction called wrong: it gives stronger protection, and the trouble is only that the strength then varies with the size of the lot.

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