CHAPTER 7

Acceptance Sampling

Expected Outcomes

Determine the AOQ curve and the AOQL for a single sampling plan.
Determine single sampling plans for stipulated producers risk and for stipulated consumers risk.
Briefly describe the different sampling plan systems.

Fundamental Aspects

Acceptance Sampling is a form of inspection applied to lots or batches of items before or after a process to judge conformance to predetermined standards.

Acceptance Sampling

Acceptance Sampling is very useful when:

- Large numbers of items must be processed in a short amount of time.
- The cost of "passing defectives" is low.
- Fatigue/boredom is caused by inspecting large numbers of items.

Acceptance Sampling

- Three important aspects of sampling:
  - Involves random sampling of the entire lot
  - Accept and Reject Lots (does not improve the quality) "Lot Sentencing"
  - Audit Tool
- Three approaches to "lot sentencing":
  - Accept with no inspection
  - 100% inspection
  - Acceptance Sampling

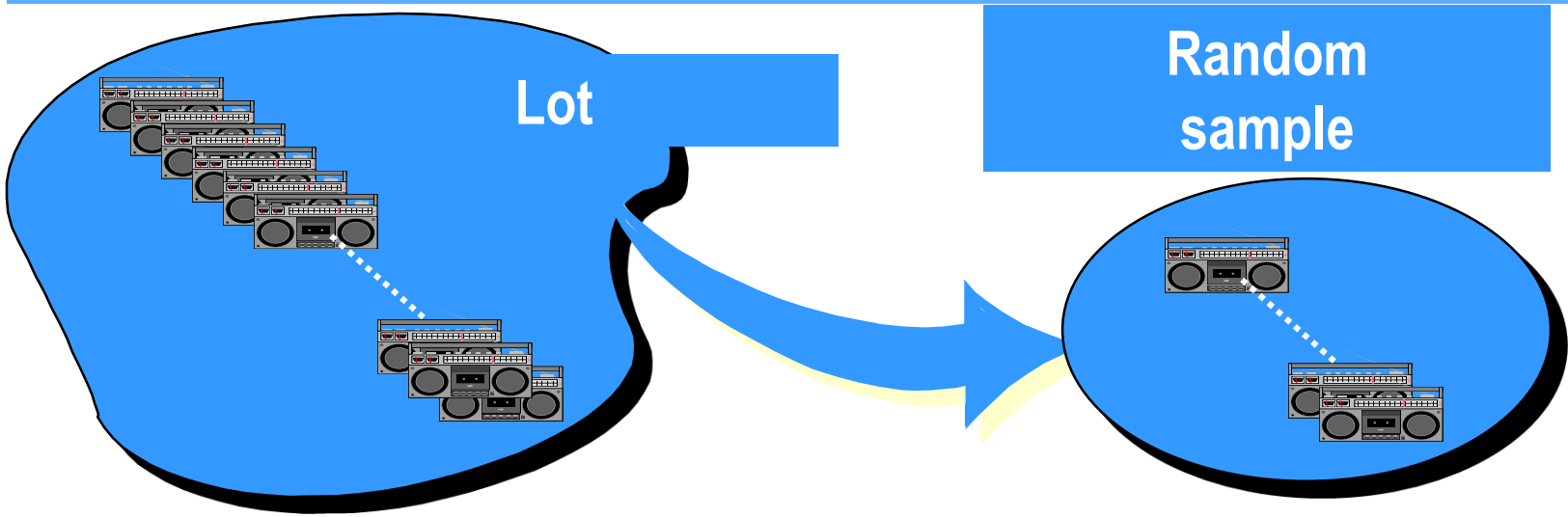
Acceptance Sampling

- Advantages
  - Places responsibility where it belongs
  - Less expensive
  - Improves inspectors job.
  - Applies to destructive testing
  - Lots are not accepted giving motivation for improvement

Sampling Plans

Sampling Plans specify the lot size, sample size, number of samples and acceptance/rejection criteria.

Sampling plans involve: Single sampling, Double sampling, Multiple sampling, & Sequential



Sampling Plans

Single Sampling Plan

N = lot size

n = sample size

c =acceptance number

If c or less non-conforming units are found in the sample, the lot is accepted, else it is rejected.

Single Sampling Plan

A single sampling plan is one where:

- A representative sample of n items is drawn from a lot size of N items
- Each item in the sample is examined and classified as good/defective
- If the number of defective exceeds a specified rejection number (c) the whole lot is rejected; otherwise the whole lot is accepted

Double Sampling Plan

A *Double Sampling Plan* allows to take a second sample if the results of the original sample are inconclusive.

- Specifies the lot size, size of the initial sample, the accept/reject/inconclusive criteria for the initial sample (*N, n1, c1 (Ac), r1(Re)*)
- Specifies the size of the second sample and the acceptance/rejection criteria based on the total nonconformities observed in both the first and second sample (*n2,c2,r2)*

Double Sampling Plan

- A first sample is taken with three possible decisions:
  - If the quality is very good, ≤ c_1 accept lot
  - If the quality is very bad, ≥ reject lot
  - If between c_1 and r_1, take a second sample
- Second sample is accepted if the total nonconformities are ≤ c_2 or rejected if the total nonconformities are ≥ r_2

Multiple Sampling Plan

A *Multiple Sampling Plan* is similar to the double sampling plan in that successive trials are made, each of which has acceptance, rejection and inconclusive options.

Decision on Which Plan to Use

- Simplicity – Single would be best and sequential the poorest.
- Administrative costs – Least under single and greatest under sequential.
- Units inspected – Greatest under single and least under sequential.
- Information – Best under single and poorest under sequential.
- Psychological Impact – Best under double.

Lot Formation

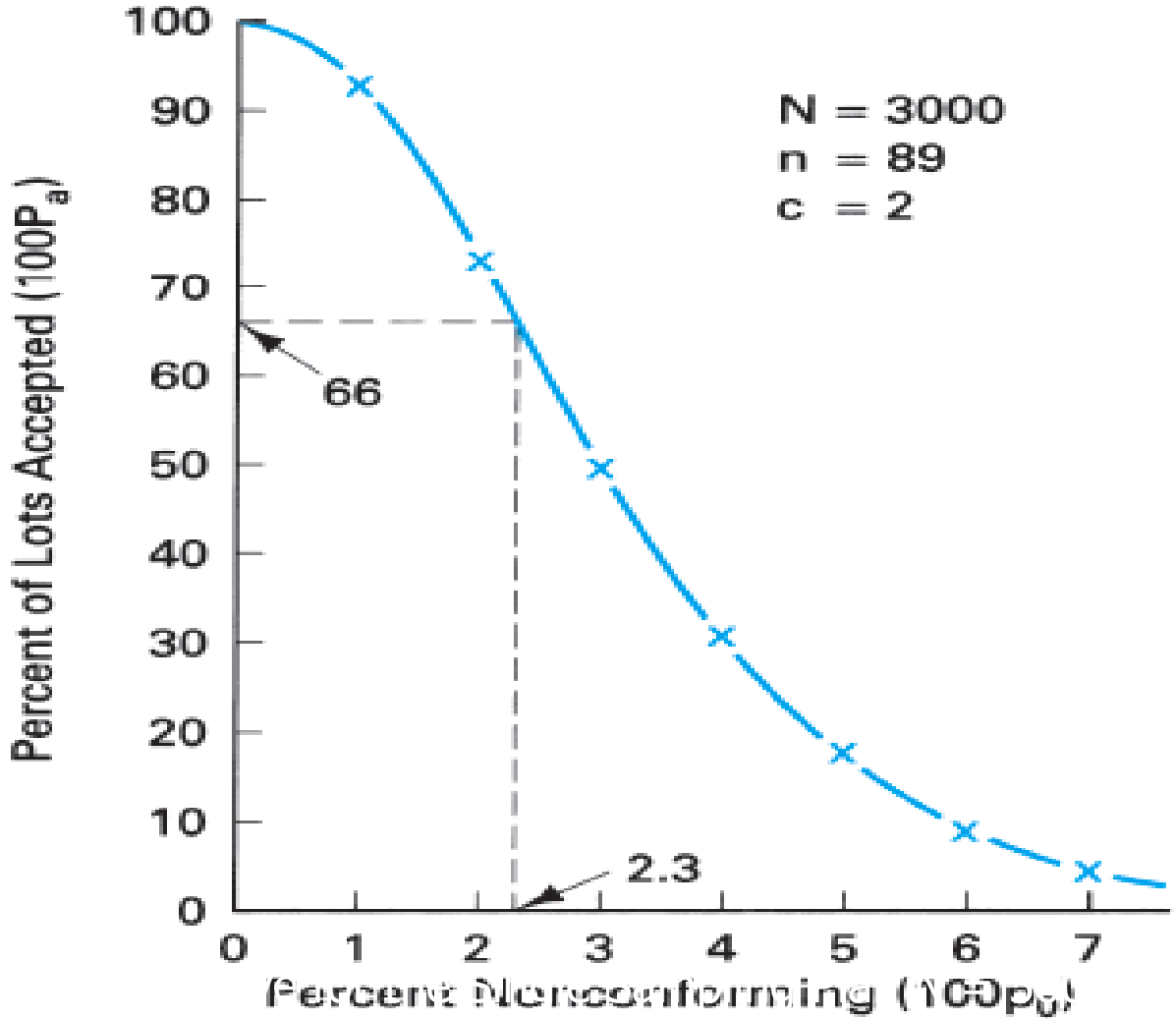
Considerations before inspection:

- Lots should be homogeneous
- Larger lots are more preferable than smaller lots
- Lots should be conformable to the materials-handling systems used in both the vendor and consumer facilities

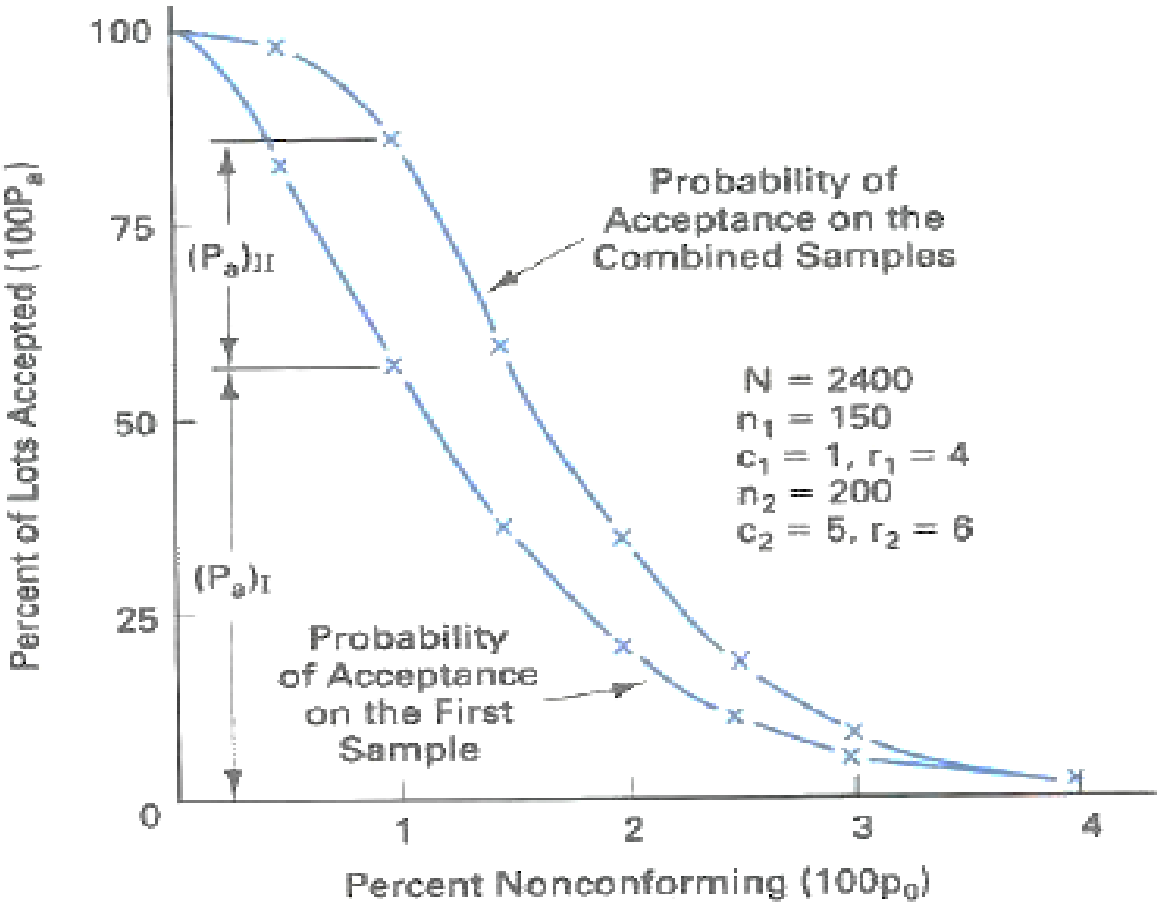
Statistical Aspects

The Operating Characteristic Curve:

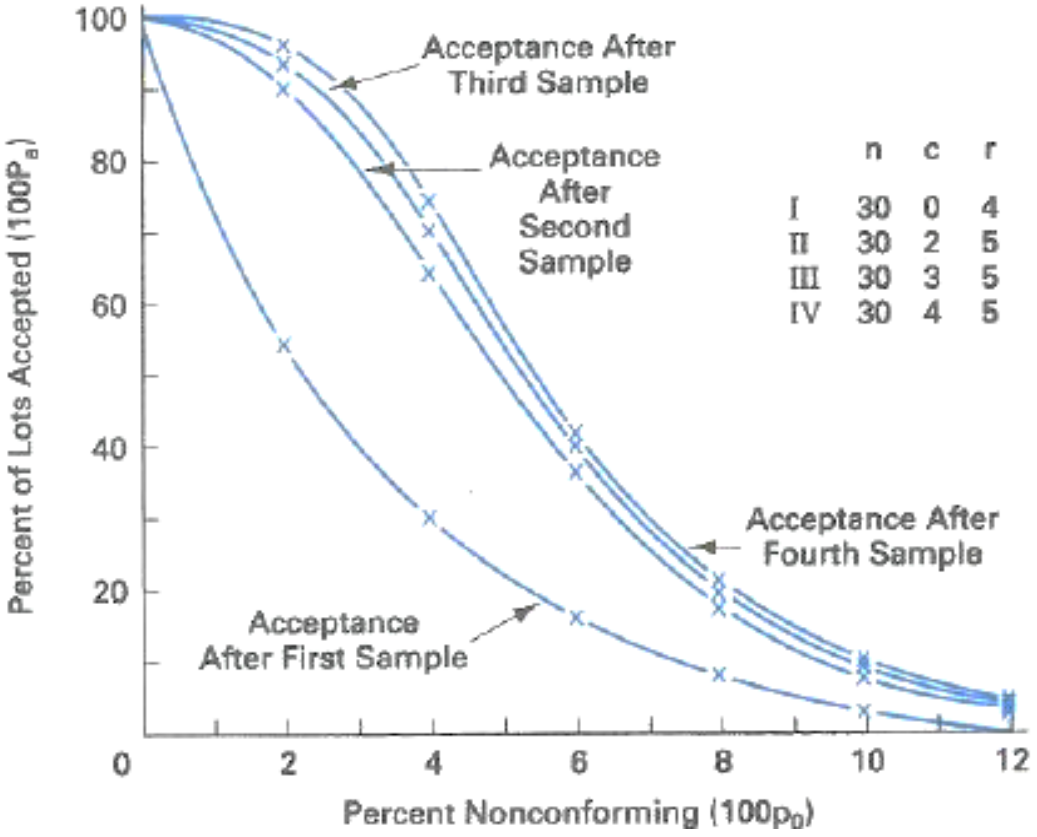
- Measures the performance of an acceptance sampling plan
- Plots the probability of accepting the lot versus the lot fraction defective
- Shows the probability that a lot submitted with a certain fraction defective will be either accepted or rejected


N = 3000
n = 89
c = 2
66
2.3
Percent of Lots Accepted (100P_a)
Percent Nonconforming (100p_0)
100
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7

OC Curve for Double Sampling Plan



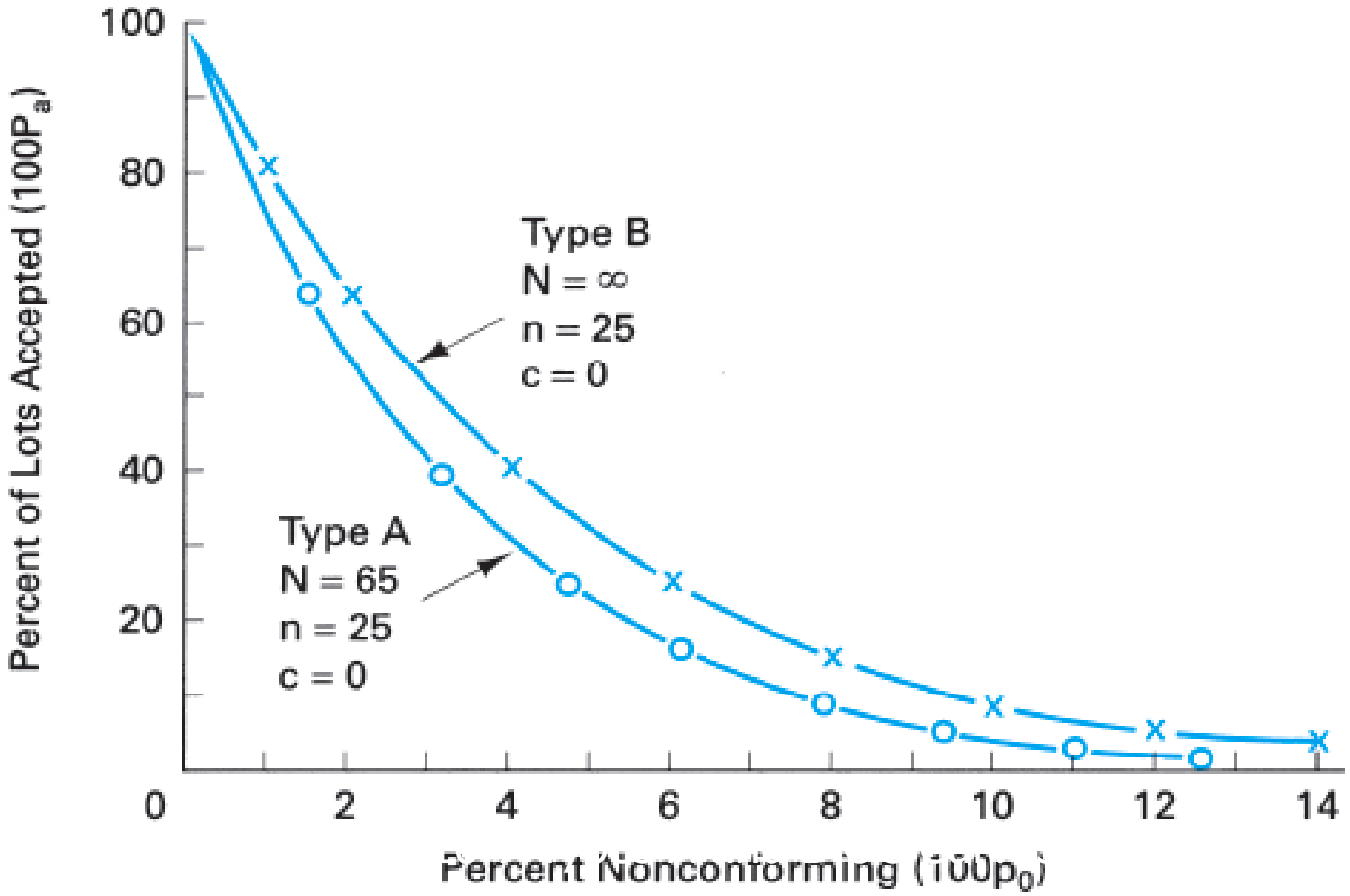
OCC for a Multiple Sampling Plan



OC Curves

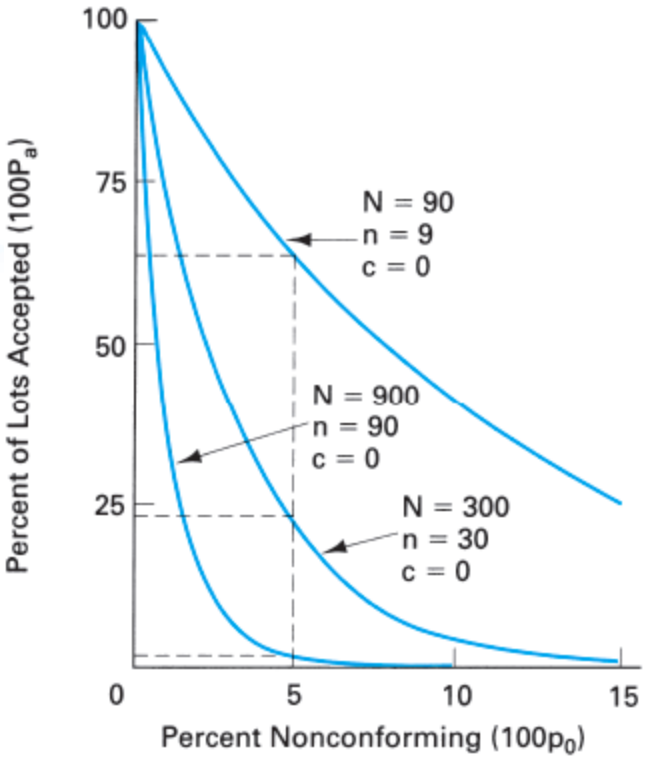
There are two types of OC curves:

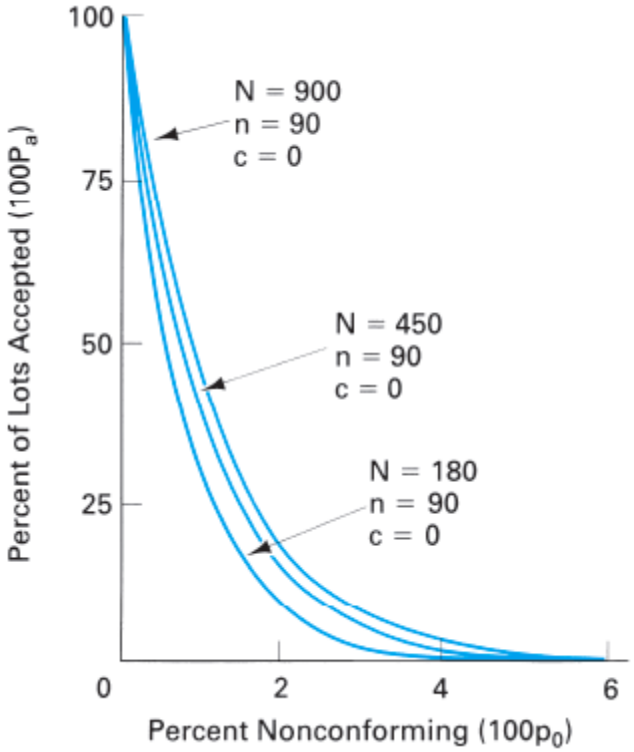
- Type A
  - Gives the probability of acceptance of an individual lot coming from finite production
- Type B
  - Gives the probability of acceptance for lots coming from a continuous production


Percent of Lots Accepted ($100P_a$)
100
80
60
40
20
0
2
4
6
8
10
12
14
Percent Nonconforming ($100p_0$)
Type B
N = ∞
n = 25
c = 0
Type A
N = 65
n = 25
c = 0

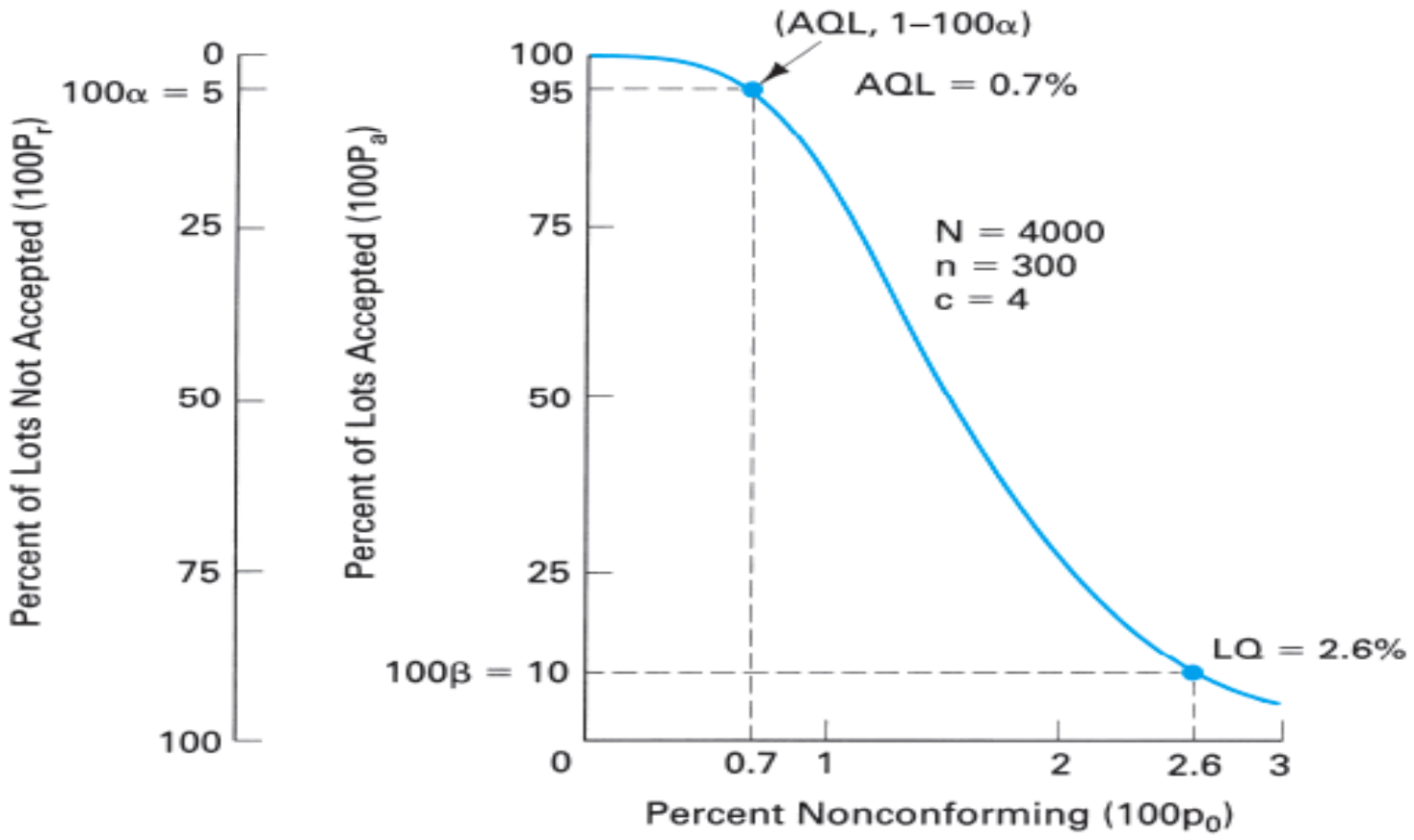
OC Curve Properties

- Sample size as a fixed % of lot size.
- Sample size that is 10% of lot size.
- Larger the sample size, the curve gets steeper.
- Decrease the acceptance number, the the curve gets steeper.


100
75
50
25
0
5
10
15
Percent of Lots Accepted ($100P_a$)
Percent Nonconforming ($100p_0$)
N = 90
n = 9
c = 0
N = 900
n = 90
c = 0
N = 300
n = 30
c = 0

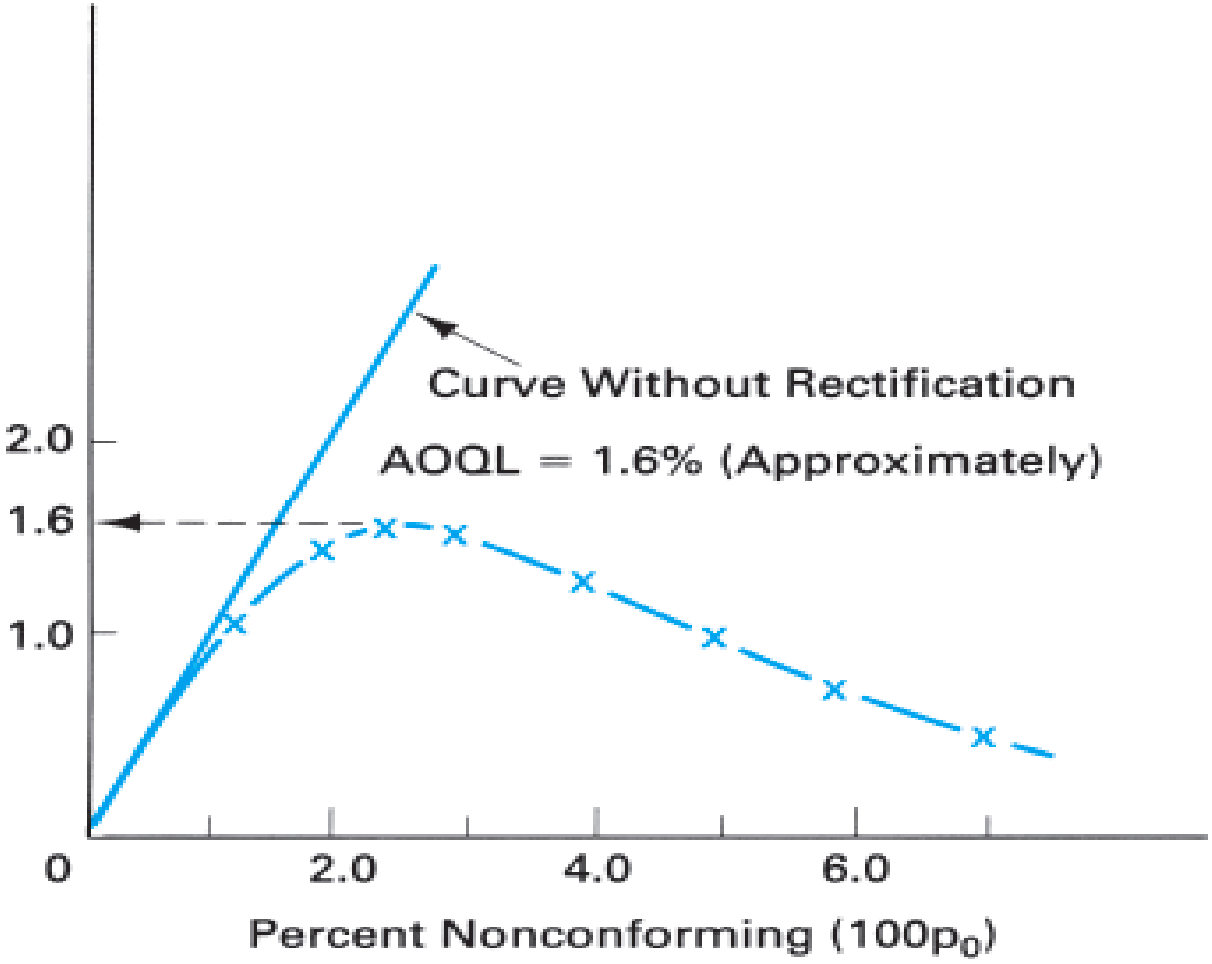

100
75
50
25
0
2
4
6
Percent of Lots Accepted ($100P_a$)
Percent Nonconforming ($100p_0$)
N = 900
n = 90
c = 0
N = 450
n = 90
c = 0
N = 180
n = 90
c = 0

Customer-Producer Relations



Acceptable Quality Level (AQL)

- The AQL is a percent defective that is the base line requirement for the quality of the producer's product. The producer would like to design a sampling plan such that there is a *high probability of accepting* a lot that has a defect level less than or equal to the AQL.


Curve Without Rectification
AOQL = 1.6% (Approximately)
2.0
1.6
1.0
0
2.0
4.0
6.0
Percent Nonconforming (100p0)

Average Outgoing Quality Limit

- A plot of the *AOQ* (Y-axis) versus the incoming lot *p* (X-axis) will start at 0 for $p = 0$, and return to 0 for $p = 1$ (where every lot is 100% inspected and rectified). In between, it will rise to a maximum. This maximum, which is the worst possible long term *AOQ*, is called the Average Outgoing Quality Limit *AOQL*.