Chapter VI

Dependent Mixed Sampling Plans with Six Sigma Quality Level as the Indexing Parameter
CHAPTER VI
DEPENDENT MIXED SAMPLING PLANS WITH SIX SIGMA QUALITY LEVEL AS THE INDEXING PARAMETER

"Six Sigma initiatives is the most popular tool used to construct management problem into a statistical problem and to find a statistical solution then connect it to a management solution".

The Six Sigma Quality level (SSQL) introduced by Radhakrishnan and Sivakumaran (2008), is a point on the OC curve by assuming the probability of acceptance of the lot $P_a(p)$ as $1-3.4 \times 10^{-6}$. Radhakrishnan and Sivakumaran (2008) further studied and constructed sampling plans indexed through six sigma quality levels. SSQL-1 and SSQL-2 where $\alpha=3.4 \times 10^{-6}$. Sampling plans constructed with a point on the OC curve (SSQL-1, 1-$\alpha_1$) is similar to (AQL, 1-$\alpha$) plan suggested by Dodge and Romig (1942). The proportion defective corresponding to the probability $2\alpha_1$ in the OC curve is termed as SSQL-2. Sampling Plans were constructed with a point on the OC curve (SSQL-2, $\gamma_1$) where $\gamma_1=2\alpha_1$ is similar to (LQL, $\beta$) suggested by Dodge and Romig (1942).

Further Radhakrishnan (2009) constructed six sigma based Single Sampling Plans with intervened random effect Poisson distribution and weighted Poisson distribution as a base line distribution. He has also incorporated the idea of six sigma quality levels in the construction of Mixed Sampling Plan and reliability based Six Sigma plan. Radhakrishnan and Sampath Kumar (2009) contributed the Six Sigma Sampling plans (independent) based on Six Sigma Quality levels. Radhakrishnan and Balamurugan (2009, 2010) provided procedure for the construction of Six Sigma based control charts for the companies implementing six sigma initiatives in their organization.

In this technological improved environment, most of the organizations in the developed and developing countries aim to create six sigma implementation which results
in nearly zero non-conformities. In those organizations which practices Six Sigma initiatives, the Six Sigma based Sampling Plans have the necessity to be developed in place of classical acceptance sampling plans.

In this chapter, dependent mixed sampling plan indexed through SSQ-1 and SSQ-2 are constructed and the tables are also provided for the easy selection of the plan.

Section 6.1 deals with construction and selection of dependent mixed sampling plan with Single Sampling Plan as attribute plan indexed through SSQ-1 and in Section 6.2, construction and selection of dependent mixed sampling plan with Single Sampling Plan as attribute plan indexed through SSQ-2 are discussed.

Section 6.1
CONSTRUCTION OF DEPENDENT MIXED SAMPLING PLAN
INDEXED THROUGH SSQ-1

6.1.1 Introduction

Mixed sampling plan is a two stage sampling procedure involving variables inspection in the first stage and attributes inspection in the second stage, if the variables inspection of the first sample does not lead to acceptance. Use of variables in the first sample with attributes on the second sample combines the economy of variables for quick acceptance on the first sample with the broad non-parametric protection of attributes sampling when a questionable lot requires a second sample. Mixed sampling plans are of two types, namely independent and dependent plans. Independent mixed plans do not incorporate first sample results in the assessment of the second sample. Dependent mixed plans do not incorporate first sample results in the assessment of the second sample. Dependent mixed plan combines the results of the first and second samples in making a decision whether a second sample is necessary.

It is the usual practice that while selecting a sampling inspection plan, to fix the operating characteristic (OC) curve in accordance with the desired degree of discrimination. The sampling plan is in turn fixed by suitably chosen parameters. The entry parameters used in the acceptance sampling literature are acceptable quality level (AQL), limiting quality level (LQL), indifference quality level (IQL) and maximum
allowable percent defective (MAPD) and Six Sigma (6σ). Several authors have provided procedures to design the sampling plans indexed through these parameters for various acceptance sampling plans.

The mixed sampling plans have been designed under two cases of significant interest. In the first case the sample size $n_i$ is fixed and a point on the OC curve is given. In the second case plans are designed when two points on the OC curve are given. The procedure for designing the mixed sampling plans to satisfy the above-mentioned conditions was provided by Schilling (1967). Using Schilling’s procedure, Suresh and Devarul (2002) have constructed tables for mixed sampling plans (independent case) having chain sampling plan as an attribute plan indexed through AQL and IQL separately. Radhakrishnan and Sampath Kumar (2005, 2006a, 2006b, 2007a, 2007b, 2009) have constructed mixed sampling plans (independent case) indexed through the parameters MAPD, AQL and IQL by considering the chain sampling plan, Six Sigma plan and double sampling plans as attribute plans.

In this paper, using the operating procedure of mixed sampling plan (dependent case) with Single Sampling plan as attribute plan tables are constructed for the mixed sampling plan indexed through Six Sigma. The dependent mixed sampling plan is compared with the independent mixed sampling plan indexed through Six Sigma. Suitable suggestions are also provided for future research.

6.1.2. Operating Procedure of Mixed Sampling Plan

Dependent mixed plans are those in which the probabilities of the variables and attributes constituents of the procedure are made dependent. The dependent procedure, as proposed by Savage (1955), can be summarized as follows:

1. Obtain the first sample
2. Test the first sample against a given variables acceptance criterion and
   a. Accept if the test meets the variable criterion
   b. If the test fails to meet the variables criterion,
      i. Reject if the number nonconforming in the first sample exceeds a given attributes criterion

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(ii) otherwise resample

3. Obtain a second sample if necessary [per 2b(ii)]

4. Test the results for the first and second samples taken together against the given attributes criterion and accept or reject as indicated by the test.

6.1.3. Formulation of Dependent Mixed Sampling Plan with Single Sampling Plan as Attribute Plan

The development of mixed sampling plans and the subsequent discussions are limited only to the upper specification limit ‘U’. By symmetry a parallel discussion can be made use for lower specification limits. Also it is suggested that the dependent mixed sampling plan with Six Sigma plan in the case of single sided specification (U), Standard Deviation (σ) known can be formulated by the five parameters n₁, n₂, c₁, c₂ and k. By specifying the values for the parameters a dependent plan for single sided specification, σ known would be carried out as follows:

1. Determine the five parameters with reference to ASN and OC curves
2. Take a random sample of size n₁ from the lot assumed to be large
3. If a sample average \( \bar{X} \leq A = U - k \sigma \), accept the lot
4. If a sample average \( \bar{X} > A = U - k \sigma \), examine the first sample for the number of defectives \( d₁ \) therein.
5. If \( d₁ > c₁ \), reject the lot.
6. If \( d₁ \leq c₁ \), take a random sample of n₂ from the lot and determine the number of defectives \( d₂ \) therein.
7. If in the combined sample of \( n = n₁ + n₂ \), the total number of defectives \( d = d₁ + d₂ \) is such that \( d \leq c₂ \), accept the lot.
8. If \( d > c₂ \), reject the lot.

6.1.4 Designing and Selection of Dependent Mixed Sampling Plan having Single Sampling plan as attribute plan indexed through Six Sigma Quality levels

Schilling and Dodge (1969) have given the procedure for designing the dependent mixed sampling plans when a point on OC curve and n₁ are known. This plan is
constructed with (SSQL-1, 1-α₁) where α₁=3.4x10⁻⁶ as point in the OC curve and n₁, n₂, c₁, c₂ and the other parameters are given. The procedure is given as follows:

♦ Assume that the mixed plan is dependent

♦ Let the probability of acceptance (β₁') in the first stage be β₁'.

♦ Decide the sample size n₁ (for variable sampling plan) to be used

♦ Calculate the acceptance limit for the variable sampling plan as

\[ A = U - k \sigma = U - \left\{ z \left( \beta_1' \right) + \left\{ \frac{z \left( \beta_1' \right)}{\sqrt{n_1}} \right\} \right\} \sigma, \]

where z (t) is the standard normal variate corresponding to 't' such that \[ t = \int_{z(t)}^{\infty} \frac{1}{\sqrt{2\pi}} e^{-u^2/2} du \]

♦ Determine the appropriate second stage sample of size n₂, c₁ and c₂ from the relation

\[ P_1(p) = P(X \leq A) + \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} P_{n_1}(i, \bar{X} > A)P(j; n_2) \quad \text{for} \quad p=p_1 \quad \text{...} \]  

(6.1.1)

Using the above procedure tables can be constructed to facilitate easy selection of dependent mixed sampling plan with Single Sampling plan as attribute plan indexed through Six Sigma.

6.1.5 Construction of Tables

Under the assumption of Poisson model, the OC function of the dependent mixed sampling plan having Single Sampling Plan is given by

\[ P_1(p) = P(\bar{X} \leq A) + \sum_{i=0}^{\infty} \sum_{j=0}^{\infty} P(n_1, \bar{X} > A) \frac{e^{-np}(np)^j}{j!} \quad \text{...} \]  

(6.1.2)

The general procedure given in section 6.1.2 is used for constructing the dependent plan indexed through SSSL-1 assuming β₁ =1-3.4x10⁻⁶ and β₁' =0.4. The n₂p₁ values are calculated and presented for different values of c₁ and c₂ in table 6.1.1. using Visual Basic program.
In dependent mixed sampling plan when the acceptance number increases, the probability of acceptance will decrease. By taking the probability of acceptance as \( \beta_i \), \((\beta_i)^2\), \((\beta_i)^3\) ...and the last value as \( 1 - \sum_{i=2}^{c_i+2} (\beta_i)^{-1} \), we write the \( Pa(p) \) as follows:

\[
\beta_i = \beta_i + (1 - \beta_i) \sum_{j=0}^{c_i} \frac{e^{-np}(np)^j}{j!}, \text{ for } c_i=0
\]  
\( (6.1.3) \)

and

\[
\beta_i = \beta_i + \sum_{i=2}^{c_i+1} \sum_{j=0}^{c_i-i+2} (\beta_i)^j \frac{e^{-np}(np)^j}{j!} + [1 - \sum_{i=2}^{c_i} (\beta_i)^{-1}] \sum_{j=0}^{c_i} \frac{e^{-np}(np)^j}{j!},
\]  
\( (6.1.4) \)

for \( c_i=1,2,3,4, \ldots \).

Using the equations 6.1.2 and 6.1.3, for various values of \( c_1 \) and \( c_2 \), the values of \( n_2p \) can be calculated for a specified \( \beta_i \) and the independent mixed sampling plan can be viewed as particular case in the dependent mixed sampling plan by taking \( c_1=0 \) and \( c_2=c \). In this pattern \( n_2p \) values are calculated for a specified value of \( \beta_i=0.40 \) using Visual Basic program and presented in Table 6.1.1.

**Table 6.1.1: \( n_2p \) values of the dependent mixed six sigma plan for \( \beta_i = 0.40 \)**

<table>
<thead>
<tr>
<th>( c_2 )</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0034</td>
<td>0.00327</td>
<td>0.114</td>
<td>0.2421</td>
<td>0.4247</td>
</tr>
<tr>
<td>1</td>
<td>0.0001</td>
<td>0.004</td>
<td>0.0363</td>
<td>0.1193</td>
<td>0.2575</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>0.0001</td>
<td>0.0043</td>
<td>0.0382</td>
<td>0.1243</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>0.0001</td>
<td>0.0045</td>
<td>0.00392</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0001</td>
<td>0.0045</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

**key:** \( n_2p \)

### 6.1.6 Selection of the Plan

Table 6.1.1 is used to construct the plans when \( p_1, c_1 \) and \( c_2 \) are given. For any given values of \( p_1, c_1 \) and \( c_2 \) one can determine \( n_2 \) value using \( n_2 = n_2p_1/p_1 \).
Example: Obtain the parameters of the dependent mixed sampling plan with Six Sigma plan as attribute plan for $\beta_1=0.9999996$, $\beta_1=0.40$, $p_1=0.000005$, $c_1=2$ and $c_2=2$.

Solution: For the given values of $p_1=0.000005$, $c_1=2$ and $c_2=2$, from Table 6.1.1, the second stage sample size $n_2= n_2 p_1 / p_1 = 0.0001 / 0.000005 = 20$. Thus $n_2= 20$, $c_1=2$ and $c_2=2$ are the parameters selected for the dependent mixed sampling plan with Six Sigma plan as attribute plan for a specified $p_1=0.000005$, $c_1=2$ and $c_2=2$.

Practical Problem:
Suppose the plan $n_1= 10$, $k = 1.5$, $c_1=2$ and $c_2=2$ is to be applied to the lot-by-lot acceptance inspection of a cell phone battery. The characteristic to be inspected is the “operating temperature and ambient temperature” of the battery for which there is a specified upper limit of $104.0^\circ F$ with a known standard deviation ($\sigma$) of $2.0^\circ F$.

In this example, $U = 104.0^\circ F$, $\sigma = 2.0^\circ F$ and $k = 1.5$.

$$A = U - k \sigma = 104.0 - (1.5)(2.0) = 101.0^\circ F$$

Now, by applying the variable inspection first, take a random sample of size $n_1=10$ from the lot. Record the sample results and find $\bar{X}$. If $\bar{X} \leq A = U - k \sigma = 101.0^\circ F$, accept the lot otherwise examine the first sample ($n_1=10$) for the number of defectives $d_1$. If the temperature of any battery is greater than $101^\circ F$, then it is termed as defective. If $d_1 > c_1 = 2$, reject the lot. If $d_1 \leq c_1$, take a random sample of the size $n_2$ and apply attribute inspection.
Take a second sample of $n_2=20$ batteries from the same and inspect the operating temperature of the battery and find the number of defectives $d_2$ in the second sample. If in the combined sample of $n = n_1 + n_2 = 30$, the total number of defectives $d = d_1 + d_2$ is such that $d \leq c_2 = 5$, accept the lot and if $d_2 > c_2 = 5$, reject the lot and inform the management for corrective action.

6.1.7. Comparison of dependent and independent mixed sampling plans indexed through SSQ-1.

In this section dependent MSP with Single Sampling Plan as attribute plan indexed through Six Sigma is compared with the independent MSP with Single Sampling Plan as attribute plan indexed through Six Sigma Quality level 1 by fixing the parameters $c_1, c_2$ and $\beta_1$ indexed through SSQ-1. A criterion for comparison is the average sample number of the two plans. The average sample number of independent and dependent mixed sampling plans is calculated as

$$\text{ASN (independent)} = n_1 + P(\bar{X} > A) n_2$$  \hspace{1cm} (6.1.5)

$$\text{and ASN (dependent)} = n_1 + n_2 \sum_{i=0}^{c_1} p_1(i, \bar{X} > A)$$ \hspace{1cm} (6.1.6)

The probability of acceptance of the independent mixed sampling plan is given as

$$P_a(p) = P(\bar{X} \leq A) + P(\bar{X} > A) \sum_{j=0}^{c_1} P(j; n_2) p^j (1-p_1)^{n_2-j}$$  \hspace{1cm} (6.1.7)

For a given values of $p_1, c_1$ and $c_2$ with $\beta_1 = 0.40$ one can find the values of $n_2$, indexed through Six Sigma using $n_2 = n_2 p_1 / p_1$ from Table 6.1.1, the values of $n_2$ and ASN are calculated for dependent and independent mixed sampling plans and presented in Table 6.1.2.

<table>
<thead>
<tr>
<th>$c_1$</th>
<th>$c_2$</th>
<th>Dependent $n_2$</th>
<th>Dependent ASN</th>
<th>Independent $n_2$</th>
<th>Independent ASN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>20</td>
<td>680</td>
<td>20</td>
<td>418</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>20</td>
<td>6540</td>
<td>20</td>
<td>3934</td>
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<td>3</td>
<td>3</td>
<td>20</td>
<td>22080</td>
<td>20</td>
<td>13258</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>20</td>
<td>48480</td>
<td>20</td>
<td>29098</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>20</td>
<td>84940</td>
<td>20</td>
<td>50974</td>
</tr>
</tbody>
</table>

* OC curves are drawn

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Construction of OC curve

The OC curves for the plans $n_2=20$, $c_1=1$, $c_2=1$ (dependent plan) and $n_2=680$, $c=1$, values of $n_2p$ and $P_a(p)$ are presented in Figure 6.1.1. It is evident from the OC curve that the probability of acceptance is more for dependent MSPs than that of independent MSPs.

![OC curves](image)

Figure 6.1.1 OC curves of dependent and independent MSPs

SECTION 6.2

CONSTRUCTION OF DEPENDENT MIXED SAMPLING PLAN

INDEXED THROUGH SSQ-2

6.2.1. Designing and Selection of Dependent Mixed Sampling Plan having Single Sampling plan as attribute plan indexed through SSQ-2

Schilling and Dodge (1969) have given the procedure for designing the dependent mixed sampling plans when a point on OC curve and $n_1$ are known. This plan is constructed with $(SSQ-2, \gamma_1)$ where $\gamma_1=2\alpha_1=2\times3.4\times10^{-6}=0.0000068$ as point on the OC curve and $n_1$, $n_2$, $c_1$, $c_2$ and the other parameters, the procedure is given as follows:

- Assume that the mixed plan is dependent
- Let the probability of acceptance ($\beta_2$) in the first stage be $\beta_2$.
- Decide the sample size $n_1$ (for variable sampling plan) to be used
- Calculate the acceptance limit for the variable sampling plan as
\[ A = U - k \sigma = U - \left\{ z(p_2) + \left\{ z\left( \frac{\beta_1}{\sqrt{m}} \right) \right\} \right\} \sigma, \] where \( z(t) \) is the standard normal variate corresponding to \( t \) such that \( t = \int_{\eta(t)}^{\pi} \frac{1}{\sqrt{2 \pi}} e^{-u^2/2} \, du \)

- Determine the appropriate second stage sample of size \( n_2, c_1 \) and \( c_2 \) from the relation

\[ P_a(p) = P(X \leq A) + \sum_{i=0}^{c_1} \sum_{j=0}^{c_2} P_n(i, X > A)P(j; n_i) \text{ for } p=p_1, \ldots \quad (6.2.1) \]

Using the above procedure, tables can be constructed to facilitate easy selection of dependent mixed sampling plan with Single Sampling plan as attribute plan indexed through SSQCL-2.

### 6.2.2 Construction of Tables

Under the assumption of Poisson model, the OC function of the dependent mixed sampling plan having Single Sampling Plan is given by

\[ P_a(p) = P(X \leq A) + \sum_{i=0}^{c_i} \sum_{j=0}^{c_2} P_n(i, X > A) e^{-np} \left( \frac{(np)^j}{j!} \right) \quad \text{... (6.2.2)} \]

The general procedure given in section 6.2.2 is used for constructing the dependent plan indexed through SSQCL-2 assuming \( \beta_2 = 2 \times 3.4 \times 10^{-6} = 0.0000068 \) and \( \beta_2 = 0.0000034 \). The \( n_2 p_1 \) values are calculated and presented for different values of \( c_1 \) and \( c_2 \) in Table 6.1.1 using Visual Basic program.

In dependent mixed sampling plan when the acceptance number increases, the probability of acceptance will decrease. By taking the probability of acceptance as \( \beta_2' \), \( (\beta_2')^2 \), \( (\beta_2')^3 \) \ldots and the last value as \( 1 - \sum_{i=2}^{c_2} (\beta_2')^{i-1} \), we write the \( P_a(p) \) as follows:

\[ \beta_2 = \beta_2' + (1 - \beta_2') \sum_{j=0}^{c_2} \frac{e^{-np}(n_2 p)^j}{j!}, \text{ for } c_1 = 0 \]

\[ \beta_2 = \beta_2' + \sum_{i=2}^{c_2+1} \sum_{j=0}^{(i-1)c_2} (\beta_2')^j \frac{e^{-np}(n_2 p)^j}{j!} + [1 - (\beta_2')^{c_2}] \sum_{j=0}^{c_2} \frac{e^{-np}(n_2 p)^j}{j!}, \]

for \( c_1 = 1, 2, 3, 4, 5 \ldots \)
Using the equations 6.2.2 and 6.2.3, for various values of $c_1$ and $c_2$, the values of $n_2p$ can be calculated for a specified $\beta_2$ and the independent mixed sampling plan can be viewed as particular case in the dependent mixed sampling plan by taking $c_1=0$ and $c_2=c$. In this pattern $n_2p$ values are calculated for a specified value of $\beta_2=0.40$ using Visual Basic program and presented in Table 6.2.1.

**Table 6.2.1: $n_2p_2$ values of the dependent mixed six sigma plan for $\beta_2=0.0000034$**

<table>
<thead>
<tr>
<th>$c_1$</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>15.3883</td>
<td>12.5918</td>
<td>17.7655</td>
<td>19.9307</td>
<td>21.9609</td>
</tr>
<tr>
<td>1</td>
<td>12.5918</td>
<td>15.3883</td>
<td>17.7655</td>
<td>19.9307</td>
<td>21.9609</td>
</tr>
<tr>
<td>2</td>
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<td>17.7655</td>
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</tr>
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<td>-</td>
<td>12.5918</td>
<td>15.3883</td>
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</tr>
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<td>-</td>
<td>-</td>
<td>12.5918</td>
</tr>
</tbody>
</table>

Key: $n_2p_2$

### 6.2.3 Selection of the Plan

Table 6.2.1 is used to construct the plans when $p_2$, $c_1$ and $c_2$ are given. For any given values of $p_2$, $c_1$ and $c_2$ one can determine $n_2$ value using $n_2 = n_2p_2/p_2$.

**Example:** Obtain the parameters of the dependent mixed sampling plan with Six Sigma plan as attribute plan for $\beta_2=0.0000068$, $\beta'_2=0.0000034$, $p_2=0.005$, $c_1=2$ and $c_2=2$.

**Solution:** For the given values of $p_2=0.000005$, $c_1=2$ and $c_2=2$, from Table 6.2.1, the second stage sample size $n_2= n_2p_2/p_2 = 12.5918 / 0.05 = 252$. Thus $n_2=252$, $c_1=2$ and $c_2=2$ are the parameters selected for the dependent mixed sampling plan with Six Sigma plan as attribute plan for a specified $p_2=0.05$, $c_1=2$ and $c_2=2$.

**Practical Problem:**

Suppose the plan $n_1=10$, $k=1.5$, $c_1=2$ and $c_2=2$ is to be applied to the lot-by-lot acceptance inspection of a car battery. The characteristic to be inspected is the “temperature” of the battery for which there is a specified upper limit of $98.0 \degree F$ with a known standard deviation ($\sigma$) of $1.0 \degree F$. 

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In this example, $U = 98.0^\circ F$, $\sigma = 1.0^\circ F$ and $k = 1.5$.

$$A = U - k\sigma = 98.0 - (1.5) (1.0) = 96.5^\circ F$$

Now, by applying the variable inspection first, take a random sample of size $n_1=10$ from the lot. Record the sample results and find $\bar{X}$. If $\bar{X} \leq A = U - k\sigma=96.5^\circ F$, accept the lot otherwise examine the first sample ($n_1=10$) for the number of defectives $d_1$. If the temperature of any battery is greater than $96.5^\circ F$, then it is termed as defective. If $d_1 > c_1 = 2$, reject the lot. If $d_1 \leq c_1$, take a random sample of the size $n_2$ and apply attribute inspection.

Take a second sample of $n_2=252$ batteries from the same and inspect the operating temperature of the battery and find the number of defectives $d_2$ in the second sample. If in the combined sample of $n = n_1 + n_2 = 262$, the total number of defectives $d = d_1 + d_2$ is such that $d \leq c_2=5$, accept the lot and if $d_2 > c_2=5$ reject the lot and inform the management for corrective action.

### 6.2.4 Comparison of dependent and independent mixed sampling plans indexed through SSQl-2

In this section dependent MSP with Single Sampling Plan as attribute plan indexed through SSQl-2 is compared with the independent MSP with Single Sampling Plan as attribute plan indexed through SSQl-2 by fixing the parameters $c_1$, $c_2$ and $\beta_2$. A criterion for comparison is the average sample number of the two plans. The average sample number of independent and dependent mixed sampling plans is calculated as
ASN (independent) = n + P(\bar{X} > A)n
\tag{6.2.5}

and ASN (dependent) = n + \sum_{i=0}^{c_1} p_{n_i}(i, \bar{X} > A)
\tag{6.2.6}

The probability of acceptance of the independent mixed sampling plan is given as

\[ P_a(p) = P(\bar{X} \leq A) + P(\bar{X} > A) \sum_{j=0}^{c} P(j; n) \quad \beta = p \tag{6.2.7} \]

For a given values of \( p_2, c_1 \) and \( c_2 \) with \( \beta = 0.0000034 \) one can find the values of ‘n2’, indexed through Six Sigma using \( n_2 = n_2 p_2 / p_2 \) from Table 6.2.1, the values of \( n_2 \) and ASN are calculated for dependent and independent mixed sampling plans and presented in Table 6.2.2.

<table>
<thead>
<tr>
<th>( c_1 )</th>
<th>( c_2 )</th>
<th>Dependent</th>
<th>Independent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( n_2 )</td>
<td>ASN</td>
</tr>
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<td>1</td>
<td>1</td>
<td>252</td>
<td>161</td>
</tr>
<tr>
<td>2</td>
<td>2*</td>
<td>252</td>
<td>161</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>252</td>
<td>161</td>
</tr>
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</tr>
<tr>
<td>5</td>
<td>5</td>
<td>252</td>
<td>161</td>
</tr>
</tbody>
</table>

* OC curves are drawn

6.2.5 Construction of OC curve

The OC curves for the plans \( n_2 = 252, c_1 = 2, c_2 = 2 \) (dependent plan) and \( n_2 = 355, c = 2 \) (independent plan) based on the different values of \( n_2 p \) and \( P_a(p) \) are presented in Figure 6.2.1. It is evident from the OC curve that the probability of acceptance is more for dependent MSPD than that of independent MSPD.

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Figure 6.2.1 OC curves of dependent and independent MSPs