Advanced Statistical Tools

Acme
2007-Mar-05 : 16:17:46

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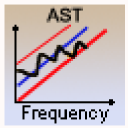
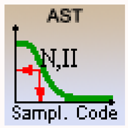
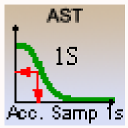
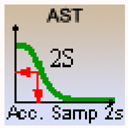
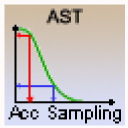
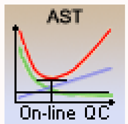
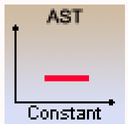
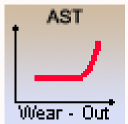
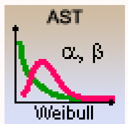
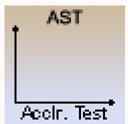
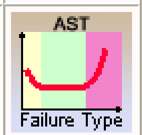
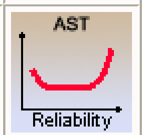
Project Introduction

Project Details	
Project Name	AST
Description	Advanced Statistical Tools
Objective	
Abstract	
Project Leader	
Commencement Date	15-Jul-2006
Project Completion Date	15-Jul-2006
Completion Date	
Status	Not Completed

Project Flow

Stages	Objective	Activities	Deliverables	Applet
1	Frequency chart	Enter Prod (alpha, AQL) and Cons (alpha, LP) and draw chart	Action area and Acceptable area lines within which control points must lie	
2	Acceptance sampling	Use tabulated sampling codes	State sampling plan with sample number, accept and reject criteria	
		Enter Prod (alpha, AQL) and Cons (alpha, LP) and draw chart	State a single sampling plan with sample number, accept and reject criteria	
		Enter Prod (alpha, AQL) and Cons (alpha, LP) and draw chart	State a double sampling plan with sample number, accept and reject criteria	
		Combined Sampling methods above	Use different applets for different purpose	
3	On-line Quality Control	Establish optimum sampling based on quality loss	State a sampling plan with sample number, frequency and accept and reject criteria	
4	Reliability	Enter failure rate and time to calculate Exp Failure and Reliability	Constant Wear Expected Failures and Reliability	
		Enter mean, stdev and time to calculate Exp Failure and Reliability	Wear Out Expected Failures and Reliability	
		Enter Alpha and Beta values to plot Weilbul curves	Plot different Weibul curves for comparison	
		Accelerated tests	To determine failure types	
		Enter data to determine failure pattern	Determine if failure pattern in largely Constant Wear or Wear Out phase	
			User different applets for different purpose	

Advanced Statistical Tools

Frequency Sampling

Badrulhisham Fauzi
Acme
2007-Mar-05 : 15:55:39

Applet Introduction

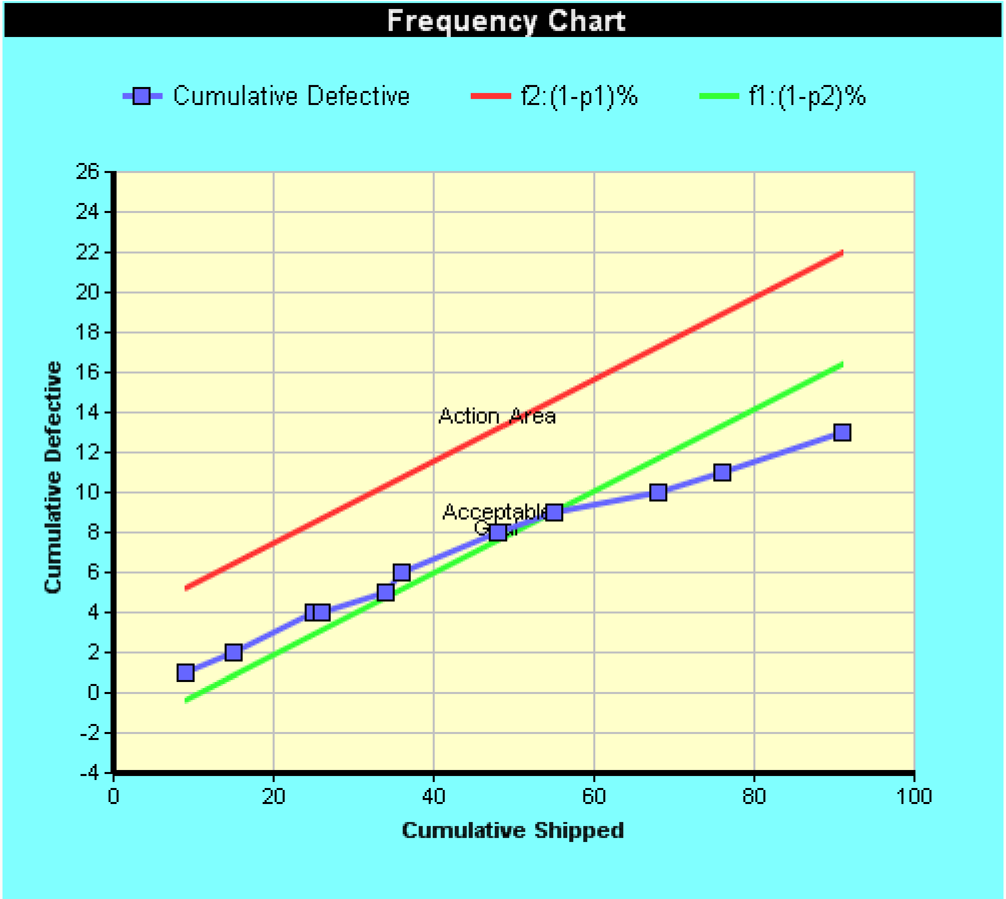
Applet Details	
Applet Title	FreqSamp
Description	Frequency Sampling
Objective	To introduce Frequency Sampling
Abstract	Frequency Sampling is a simple but important tool control the defect level on a continuous basis.
Team Leader	Badrulhisham Fauzi
Commencement Date	15-Jul-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	FreqSamp
Team Members	**1** IR0025 Fauzi Rozita

Frequency Chart

Name of the Study	Frequency Chart		
Average Quality Level (P1)	0.1	**Producer's Risk (Alpha)**	0.01
Limiting Quality (P2)	0.3	**Consumer's Risk (Beta)**	0.05

	1	2	3	4	5	6	7	8	9	
Year	2003	2003	2003	2003	2003	2003	2003	2003	2003	**Year**
Date	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	**Date**
Hours	11:41	11:41	11:41	11:41	11:41	11:41	11:41	11:41	11:41	**Hours**
Shift										**Shift**
Employee										**Employee**
Shipped	9	6	10	1	8	2	12	7	13	**Shipped**
Accepted	8	5	8	1	7	1	10	6	12	**Accepted**

	10	11	12	13	14	15	
Year	2003	2003	2006	2006	2006	2006	**Year**
Date	10/11	10/11	10/20	10/20	10/20	10/20	**Date**
Hours	11:41	11:41	16:05	16:06	16:06	16:06	**Hours**
Shift							**Shift**
Employee							**Employee**
Shipped	8	15	0	0	0	0	**Shipped**
Accepted	7	13	0	0	0	0	**Accepted**



No	Remark
	No Remarks Added.

Advanced Statistical Tools

Sampling by Codes

Bawani Ho
Acme
2007-Mar-05 : 15:56:57

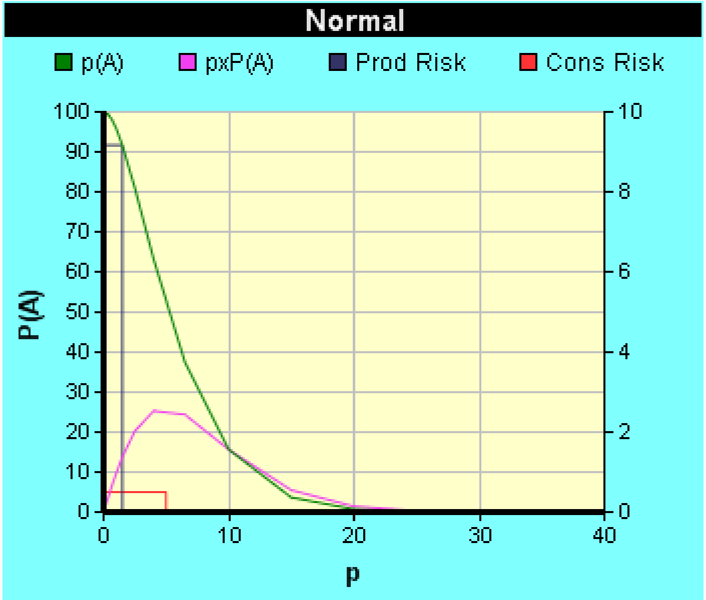
Applet Introduction

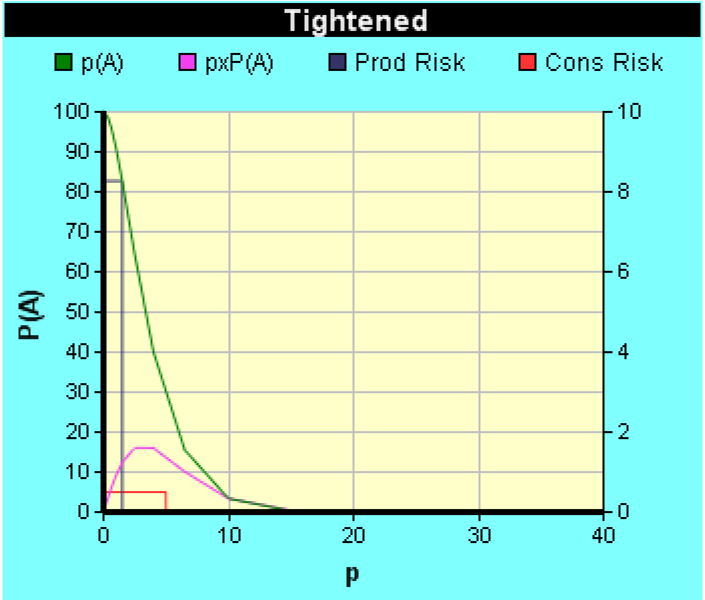
Applet Details	
Applet Title	SampCodes
Description	Sampling by Codes
Objective	To create a sampling plan based on sampling codes.
Abstract	Sampling codes provide a simple method of deriving sampling plans
Team Leader	Bawani Ho
Commencement Date	20-Aug-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	SampCodes
Team Members	**1** IR0020 Farida Sulaiman

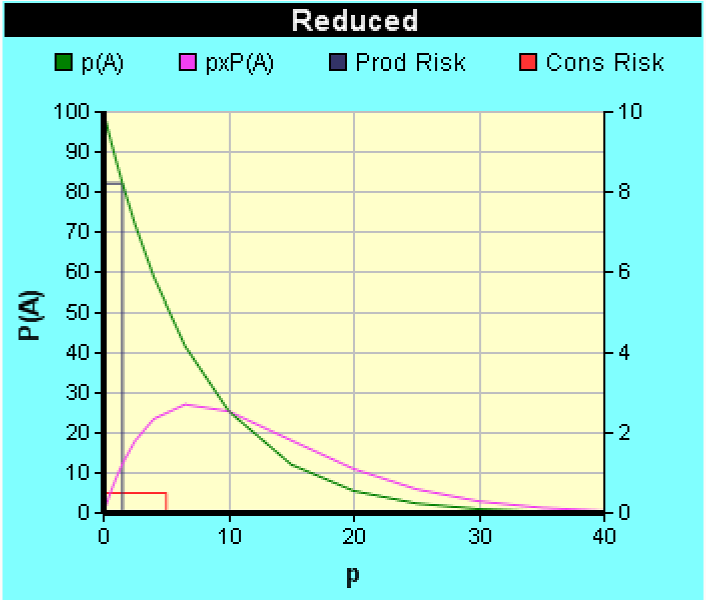
Sampling By Code

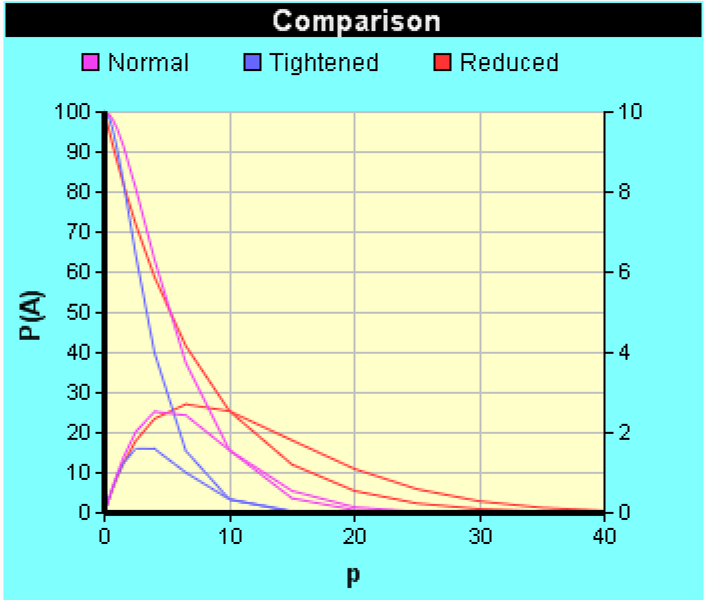
Batch Size	151-280		
Inspection Level	II		
Type	NonConforming		
AQL	1.5		
CR	5 %		
Code Letter	G		
AQL Graph Limits	40	**Interval**	10
AOQL Graph Limits	10	**Interval**	2

Sample Type	Normal	Tightened	Reduced	Units
Sample Size	32	50	13	Units
Accept	1	1	0	Units
Reject	2	2	2	Units
PR	8.3	17.27	17.84	%
Limiting Quality	5	5	5	%
AOQL	2.53	1.61	2.71	%


Normal
p(A)
pxP(A)
Prod Risk
Cons Risk
P(A)
100
90
80
70
60
50
40
30
20
10
0
10
8
6
4
2
0
0
10
20
30
40
p


Tightened
p(A)
pxP(A)
Prod Risk
Cons Risk
P(A)
100
90
80
70
60
50
40
30
20
10
0
10
8
6
4
2
0
0
10
20
30
40
p





	p	0.00	0.01	0.02	0.03	0.04	0.07	0.10	0.15	0.40	0.65	1.00	1.50	2.50	4.00	6.50	10.00	15.00	p	
Normal	P(A)	100.00	100.00	100.00	100.00	99.99	99.98	99.95	99.89	99.27	98.16	95.93	91.70	80.97	63.19	37.54	15.64	3.66	P(A)	Norma
	p x P(A)	0.00	0.01	0.01	0.02	0.04	0.06	0.10	0.15	0.40	0.64	0.96	1.38	2.02	2.53	2.44	1.56	0.55	p x P(A)	
Tightened	P(A)	100.00	100.00	100.00	99.99	99.98	99.95	99.88	99.74	98.27	95.79	91.06	82.73	64.35	40.05	15.54	3.38	0.29	P(A)	Tighte
	p x P(A)	0.00	0.01	0.01	0.02	0.04	0.06	0.10	0.15	0.39	0.62	0.91	1.24	1.61	1.60	1.01	0.34	0.04	p x P(A)	
Reduced	P(A)	100.00	99.87	99.81	99.68	99.48	99.16	98.71	98.07	94.92	91.87	87.75	82.16	71.95	58.82	41.74	25.42	12.09	P(A)	Reduc
	p x P(A)	0.00	0.01	0.01	0.02	0.04	0.06	0.10	0.15	0.38	0.60	0.88	1.23	1.80	2.35	2.71	2.54	1.81	p x P(A)	

	p	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	p	
Normal	P(A)	0.71	0.12	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	P(A)	Norma
	p x P(A)	0.14	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	p x P(A)	
Tightened	P(A)	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	P(A)	Tighte
	p x P(A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	p x P(A)	
Reduced	P(A)	5.50	2.38	0.97	0.37	0.13	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	P(A)	Reduc

	p x P(A)	1.10	0.59	0.29	0.13	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**p x P(A)**	

Advanced Statistical Tools

Single Sampling Plan

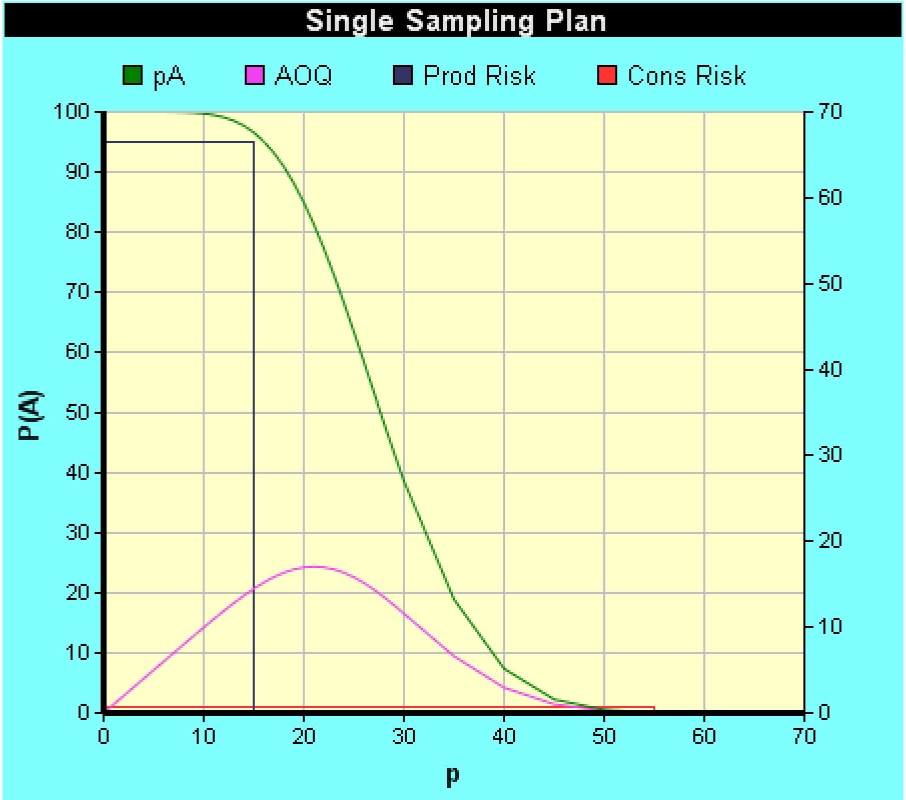
Bawani Ho
Acme
2007-Mar-05 : 15:58:47

Applet Introduction

Applet Details	
Applet Title	SSPlan
Description	Single Sampling Plan
Objective	To demonstrate the use of Single Sampling Plan
Abstract	Single Sampling Plan is used to derive suitable sampling plan based on a single sample.
Team Leader	Bawani Ho
Commencement Date	20-Aug-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	SSPlan
Team Members	**1** IR0040 Hisham Shazlee

Derivation of Single Sampling Plan

AQL	15	**Alpha**	95	**p2/p1**	3.67	**n**	31
LQ	55	**Beta**	1	**np1**	4.695	**c**	8
AQL Graph Limits	70		**Interval**	10			
AOQL Graph Limits	70		**Interval**	10			



p	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	**p**
P(A)	100.00	100.00	100.00	100.00	100.00	100.00	99.99	99.98	99.95	99.88	99.74	99.51	99.13	98.55	97.72	**P(A)**

AOQ	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	8.99	9.97	10.95	11.90	12.81	13.68	**AOQ**

p	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	**p**
P(A)	96.59	95.10	93.22	90.90	88.13	84.92	81.29	77.26	72.89	68.24	63.38	58.39	53.34	48.32	43.40	**P(A)**
AOQ	14.49	15.22	15.85	16.36	16.75	16.99	17.07	17.00	16.76	16.38	15.84	15.18	14.40	13.53	12.59	**AOQ**

p	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	**p**
P(A)	38.65	18.94	7.38	2.26	0.53	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**P(A)**
AOQ	11.59	6.63	2.95	1.02	0.27	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**AOQ**

Advanced Statistical Tools

Double Sampling Plan

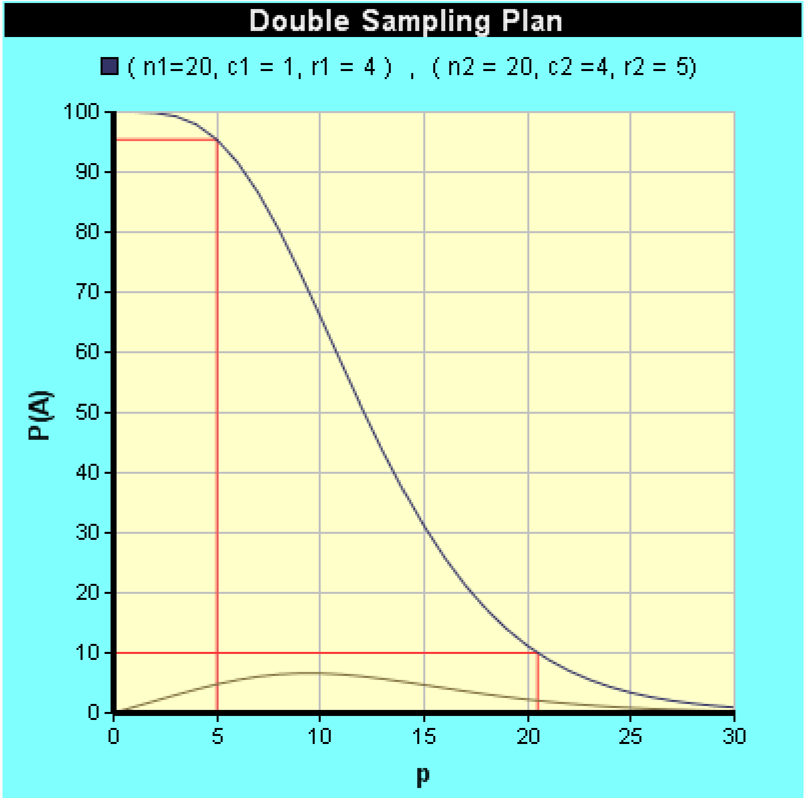
Bawani Ho
Acme
2007-Mar-05 : 16:00:01

Applet Introduction

Applet Details	
Applet Title	DSPlan
Description	Double Sampling Plan
Objective	To demonstrate the use of Double Sampling Plan
Abstract	Double Sampling Plans are necessary to provide quality assurance based on reduced sampling.
Team Leader	Bawani Ho
Commencement Date	20-Aug-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	DSPlan
Team Members	**1** IR0020 Farida Sulaiman

Double Sampling Plan

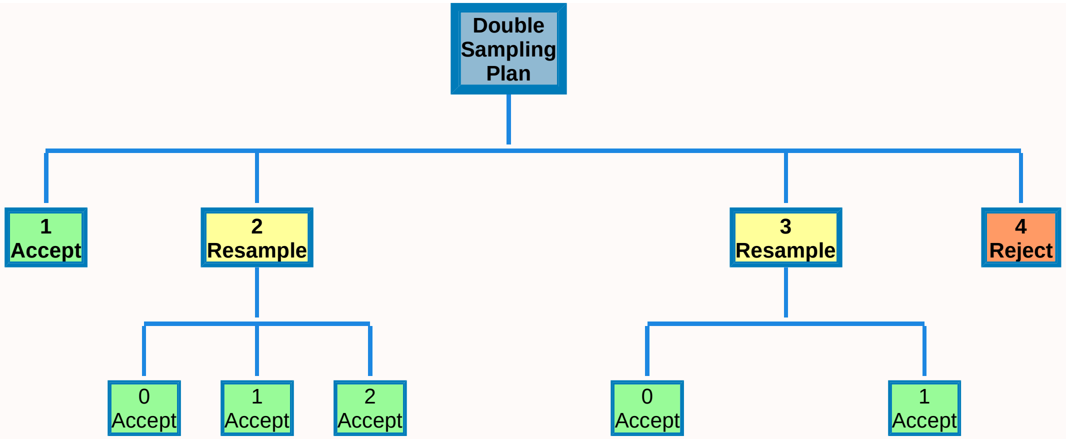
Sample Size (n1)	20	**Accept (a1)**	1	**Reject (r1)**	4
Sample Size (n2)	20	**Accept (a2)**	4	**Reject (r2)**	5
AQL	5.0	**PR**	4.59 %	**AOQL**	6.6 %
CR	10	**LQ**	20.48 %		



p	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	**p**
P(1)	100.00	98.31	94.01	88.02	81.03	73.58	66.05	58.69	51.69	45.16	39.17	33.76	28.91	24.61	20.84	17.56	**P(1)**

P(2)	0.00	1.58	5.25	9.68	13.94	17.44	19.88	21.15	21.36	20.67	19.30	17.49	15.43	13.30	11.22	9.29	**P(2)**
P(3)	0.00	0.09	0.61	1.61	2.95	4.38	5.68	6.68	7.31	7.55	7.45	7.06	6.48	5.78	5.02	4.26	**P(3)**
P(Total)	100.00	99.99	99.86	99.31	97.93	95.41	91.60	86.52	80.36	73.38	65.93	58.31	50.82	43.69	37.08	31.10	**P(Total)**
p x P(Total)	0.00	1.00	2.00	2.98	3.92	4.77	5.50	6.06	6.43	6.60	6.59	6.41	6.10	5.68	5.19	4.67	**p x P(Total)**

p	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	**p**
P(1)	14.71	12.27	10.18	8.41	6.92	5.66	4.61	3.74	3.02	2.43	1.95	1.55	1.23	0.97	0.76	**P(1)**
P(2)	7.55	6.04	4.75	3.69	2.82	2.13	1.59	1.17	0.85	0.61	0.43	0.30	0.21	0.15	0.10	**P(2)**
P(3)	3.55	2.89	2.32	1.83	1.42	1.09	0.82	0.61	0.45	0.33	0.23	0.17	0.12	0.08	0.05	**P(3)**
P(Total)	25.81	21.20	17.26	13.93	11.16	8.88	7.02	5.52	4.32	3.37	2.61	2.02	1.56	1.20	0.92	**P(Total)**
p x P(Total)	4.13	3.60	3.11	2.65	2.23	1.86	1.54	1.27	1.04	0.84	0.68	0.55	0.44	0.35	0.28	**p x P(Total)**


Double Sampling Plan
1 Accept
2 Resample
3 Resample
4 Reject
0 Accept
1 Accept
2 Accept
0 Accept
1 Accept

Advanced Statistical Tools

Sampling Techniques

Acme
2007-Mar-05 : 16:01:58

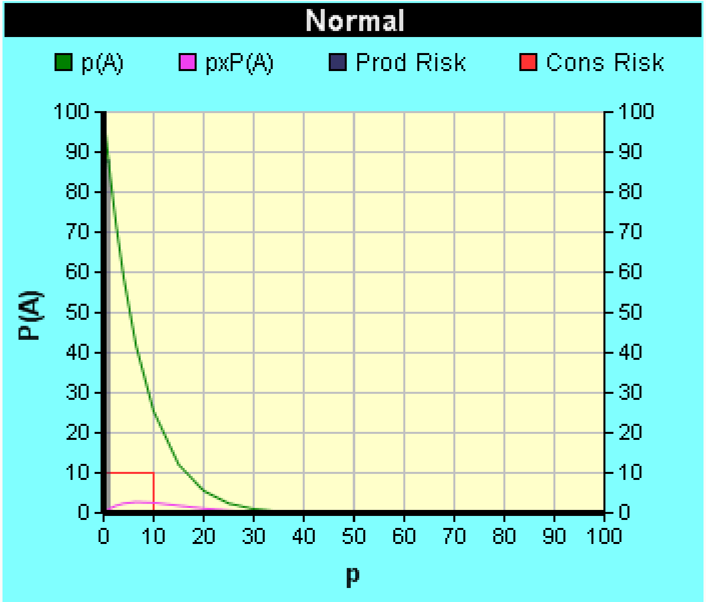
Applet Introduction

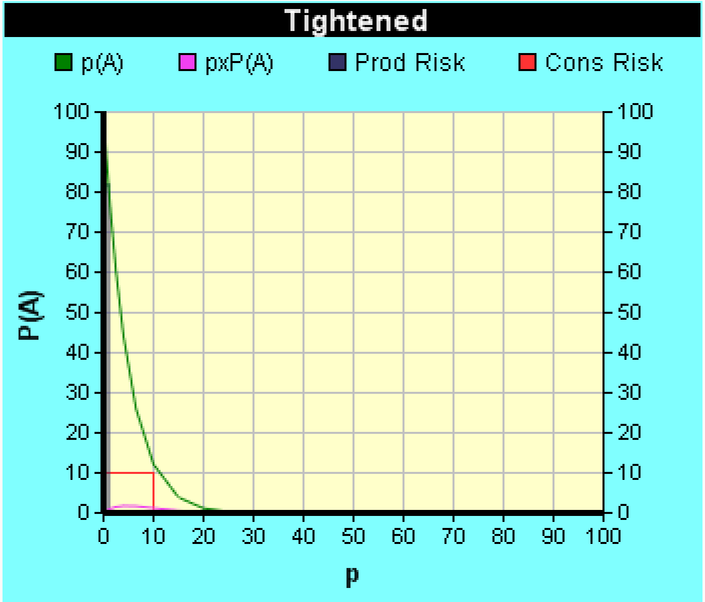
Applet Details	
Applet Title	Sampling
Description	Sampling Techniques
Objective	To demonstrate the use of Sampling Techniques
Abstract	Sampling Techniques are an important means of quality control based on attribute data.
Team Leader	
Commencement Date	15-Jul-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	Sampling
Team Members	**1** IR00123 Thulasi Vadivel

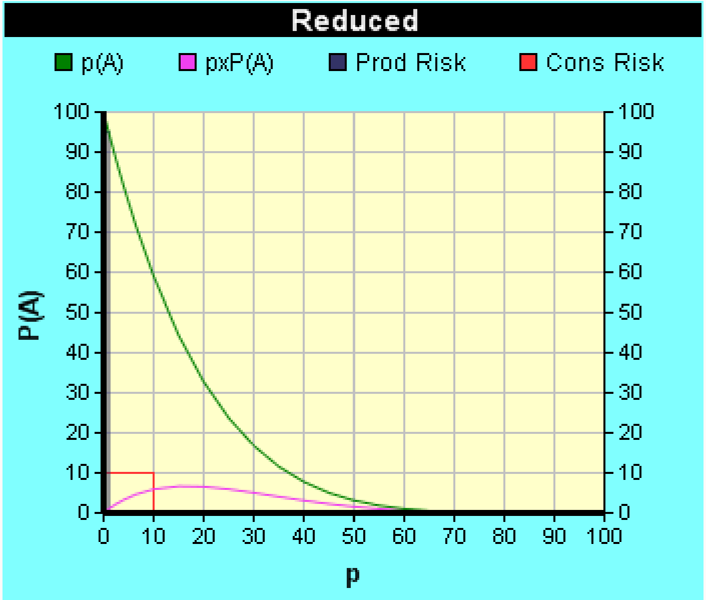
Sampling By Code

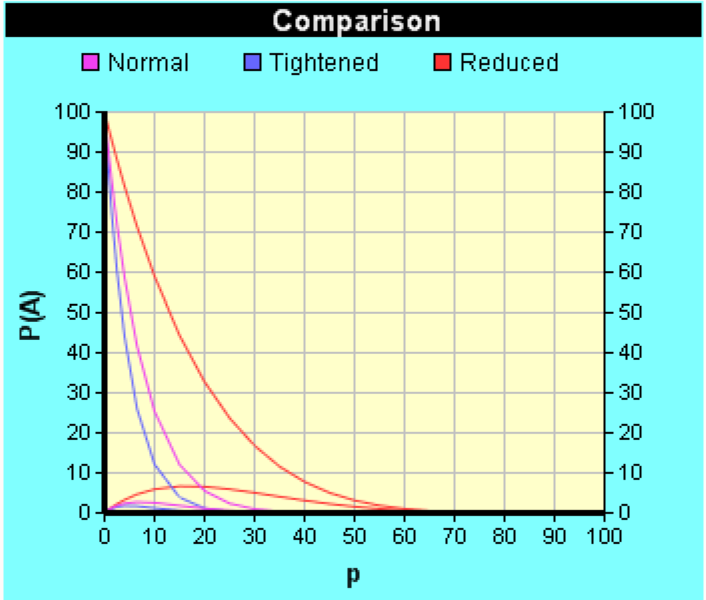
Batch Size	91-150		
Inspection Level	II		
Type	NonConforming		
AQL	1		
CR	10 %		
Code Letter	F		
AQL Graph Limits	100	**Interval**	10
AOQL Graph Limits	100	**Interval**	10

Sample Type	Normal	Tightened	Reduced	Units
Sample Size	13	20	5	Units
Accept	0	0	0	Units
Reject	1	1	1	Units
PR	12.25	18.21	4.9	%
Limiting Quality	10	10	10	%
AOQL	2.71	1.77	6.66	%


Normal
p(A)
pxP(A)
Prod Risk
Cons Risk
P(A)
p


Tightened
p(A)
pxP(A)
Prod Risk
Cons Risk
P(A)
p





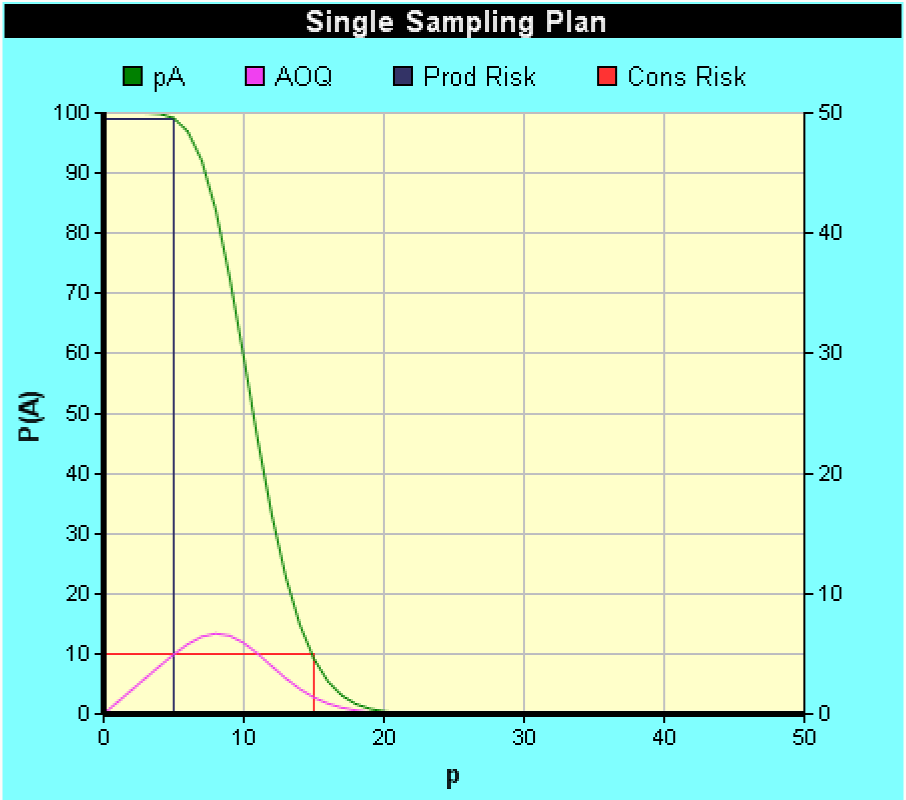
	p	0.00	0.01	0.02	0.03	0.04	0.07	0.10	0.15	0.40	0.65	1.00	1.50	2.50	4.00	6.50	10.00	15.00	p	
Normal	P(A)	100.00	99.87	99.81	99.68	99.48	99.16	98.71	98.07	94.92	91.87	87.75	82.16	71.95	58.82	41.74	25.42	12.09	P(A)	Norma
	p x P(A)	0.00	0.01	0.01	0.02	0.04	0.06	0.10	0.15	0.38	0.60	0.88	1.23	1.80	2.35	2.71	2.54	1.81	p x P(A)	
Tightened	P(A)	100.00	99.80	99.70	99.50	99.20	98.71	98.02	97.04	92.30	87.77	81.79	73.91	60.27	44.20	26.08	12.16	3.88	P(A)	Tighte
	p x P(A)	0.00	0.01	0.01	0.02	0.04	0.06	0.10	0.15	0.37	0.57	0.82	1.11	1.51	1.77	1.69	1.22	0.58	p x P(A)	
Reduced	P(A)	100.00	99.95	99.93	99.88	99.80	99.68	99.50	99.25	98.02	96.79	95.10	92.72	88.11	81.54	71.46	59.05	44.37	P(A)	Reduc
	p x P(A)	0.00	0.01	0.01	0.02	0.04	0.06	0.10	0.15	0.39	0.63	0.95	1.39	2.20	3.26	4.64	5.90	6.66	p x P(A)	

	p	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	p	
Normal	P(A)	5.50	2.38	0.97	0.37	0.13	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	P(A)	Norma
	p x P(A)	1.10	0.59	0.29	0.13	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	p x P(A)	
Tightened	P(A)	1.15	0.32	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	P(A)	Tighte
	p x P(A)	0.23	0.08	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	p x P(A)	
Reduced	P(A)	32.77	23.73	16.81	11.60	7.78	5.03	3.13	1.85	1.02	0.53	0.24	0.10	0.03	0.01	0.00	0.00	0.00	P(A)	Reduc

	p x P(A)	6.55	5.93	5.04	4.06	3.11	2.26	1.56	1.01	0.61	0.34	0.17	0.07	0.03	0.01	0.00	0.00	0.00	**p x P(A)**	

Derivation of Single Sampling Plan

AQL	5	**Alpha**	99	**p2/p1**	3	**n**	109
LQ	15	**Beta**	10	**np1**	5.428	**c**	11
AQL Graph Limits	50		**Interval**	10			
AOQL Graph Limits	50		**Interval**	10			



p	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	**p**
P(A)	100.00	100.00	100.00	99.99	99.86	99.15	96.93	92.05	83.81	72.46	59.20	45.61	33.16	22.80	14.86	**P(A)**

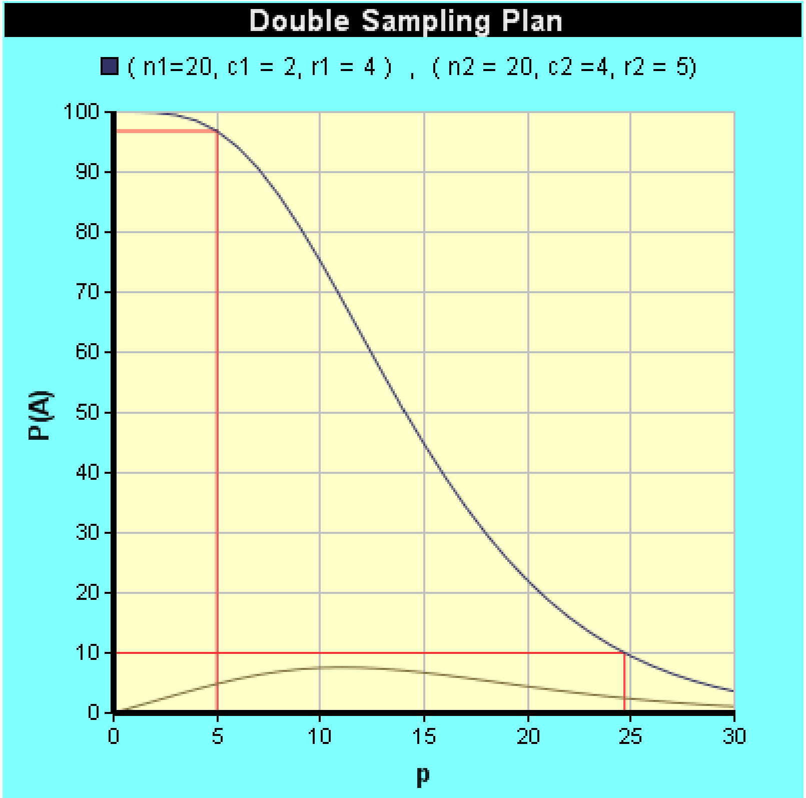
AOQ	0.00	1.00	2.00	3.00	3.99	4.96	5.82	6.44	6.71	6.52	5.92	5.02	3.98	2.96	2.08	**AOQ**

p	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	**p**
P(A)	9.21	5.44	3.07	1.66	0.86	0.43	0.21	0.10	0.04	0.02	0.01	0.00	0.00	0.00	0.00	**P(A)**
AOQ	1.38	0.87	0.52	0.30	0.16	0.09	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	**AOQ**

p	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	**p**
P(A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**P(A)**
AOQ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**AOQ**

Double Sampling Plan

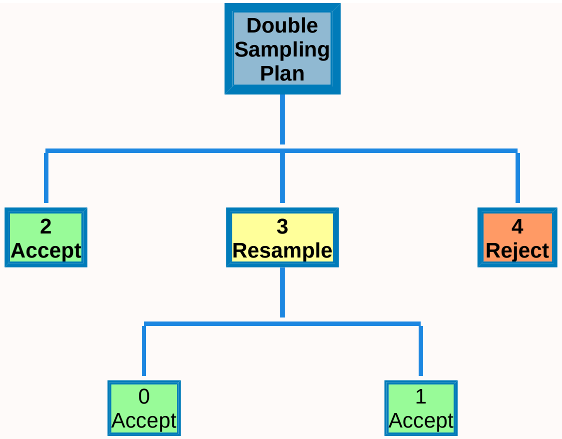
Sample Size (n1)	20	**Accept (a1)**	2	**Reject (r1)**	4
Sample Size (n2)	20	**Accept (a2)**	4	**Reject (r2)**	5
AQL	5.0	**PR**	3.16 %	**AOQL**	7.59 %
CR	10	**LQ**	24.69 %		



p	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	**p**
P(2)	100.00	99.90	99.29	97.90	95.61	92.45	88.50	83.90	78.79	73.34	67.69	61.98	56.31	50.80	45.50	40.49	**P(2)**

P(3)	0.00	0.09	0.61	1.61	2.95	4.38	5.68	6.68	7.31	7.55	7.45	7.06	6.48	5.78	5.02	4.26	**P(3)**
P(Total)	100.00	99.99	99.90	99.51	98.57	96.84	94.18	90.58	86.10	80.90	75.14	69.04	62.79	56.57	50.52	44.75	**P(Total)**
p x P(Total)	0.00	1.00	2.00	2.99	3.94	4.84	5.65	6.34	6.89	7.28	7.51	7.59	7.54	7.35	7.07	6.71	**p x P(Total)**

p	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	**p**
P(2)	35.80	31.46	27.48	23.86	20.61	17.70	15.12	12.84	10.85	9.13	7.63	6.35	5.26	4.33	3.55	**P(2)**
P(3)	3.55	2.89	2.32	1.83	1.42	1.09	0.82	0.61	0.45	0.33	0.23	0.17	0.12	0.08	0.05	**P(3)**
P(Total)	39.35	34.35	29.80	25.69	22.03	18.79	15.94	13.45	11.30	9.45	7.87	6.52	5.37	4.41	3.60	**P(Total)**
p x P(Total)	6.30	5.84	5.36	4.88	4.41	3.94	3.51	3.09	2.71	2.36	2.05	1.76	1.50	1.28	1.08	**p x P(Total)**


Double Sampling Plan
2 Accept
3 Resample
4 Reject
0 Accept
1 Accept

Advanced Statistical Tools

Online Quality Control

Acme
2007-Mar-05 : 16:03:03

Applet Introduction

Applet Details	
Applet Title	OQC
Description	Online Quality Control
Objective	Online Quality Control is based on Taguchi methodology and it is used to minimise the cost of inspection
Abstract	Online Quality Control is a new method of reducing the quality cost related to inspection.
Team Leader	
Commencement Date	15-Jul-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	OQC
Team Members	**1** IR0010 Bawani Thambu

Online Quality Control

Data

Name of the Experiment	Tesy
The type of process is	Variable
Production type	Batch
Monetary Unit	Yen
Batch Size	1 Unit
Cost of Rework	12 Yen/Unit

Cost of Measurement	5 Yen/Unit
Cost of Adjustment	10 Yen/Unit
Tolerance	5 um
Measurement error	0.833 um
Time Lag	3 Unit

Adjust Limit	3 um
Avg No. between adjustment	180 Unit
Measurement Interval	25 Unit

Optimum Calculations

Current Process	Current		Optimum	
Adjust Limit	D	3	Do	1.33
Avg No. between adjustment	u	180	uo	35
Measurement Interval	n	25	no	21

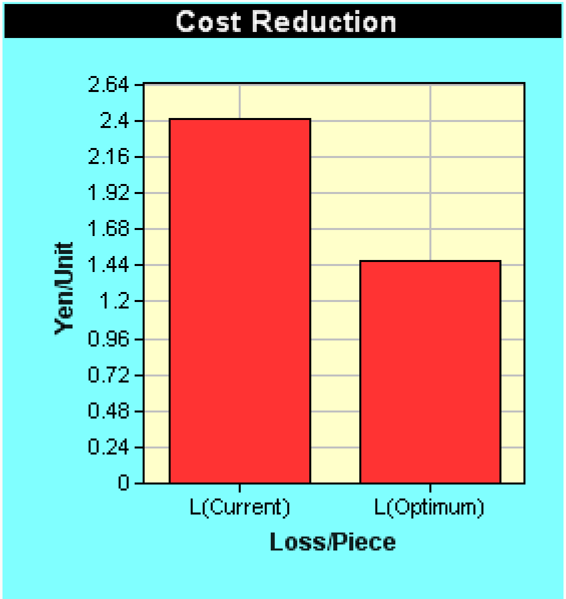
Diagnosis cost per product	L1$	0.2	L1o$	0.23
Adjustment cost per product	L2$	0.06	L2o$	0.28
Loss by deviation (within spec)	L3$	1.44	L3o$	0.28
Loss by deviation (without spec)	L4$	0.31	L4o$	0.27
Loss by deviation (lag)	L5$	0.07	L5o$	0.07
Loss by meas error	L6$	0.33	L6o$	0.33

Loss/piece	L(Current)	2.41	L(Optimum)	1.47

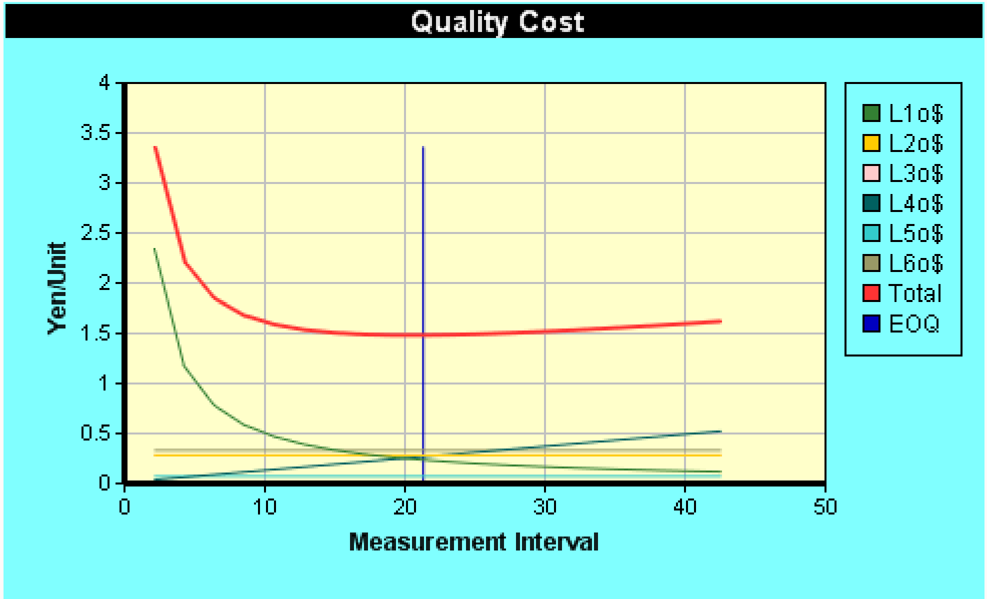
Cost Reduction				38.94

Spec Spread	10 um
Process Spread	7.182 um
Process Capability	1.392

Graph of Cost Reduction



Graph of Quality Cost



Quality Cost Calculations

Measurement	L1o$	L2o$	L3o$	L4o$	L5o$	L6o$	Total
2.131	2.346	0.283	0.283	0.038	0.072	0.333	3.355
4.262	1.173	0.283	0.283	0.063	0.072	0.333	2.207
6.393	0.782	0.283	0.283	0.089	0.072	0.333	1.842
8.524	0.587	0.283	0.283	0.114	0.072	0.333	1.672
10.655	0.469	0.283	0.283	0.140	0.072	0.333	1.580
12.786	0.391	0.283	0.283	0.165	0.072	0.333	1.527

14.917	0.335	0.283	0.283	0.191	0.072	0.333	1.497
17.048	0.293	0.283	0.283	0.217	0.072	0.333	1.481
19.179	0.261	0.283	0.283	0.242	0.072	0.333	1.474
21.310	0.235	0.283	0.283	0.268	0.072	0.333	1.473
23.441	0.213	0.283	0.283	0.293	0.072	0.333	1.477
25.572	0.196	0.283	0.283	0.319	0.072	0.333	1.485
27.703	0.180	0.283	0.283	0.344	0.072	0.333	1.496
29.834	0.168	0.283	0.283	0.370	0.072	0.333	1.508
31.965	0.156	0.283	0.283	0.396	0.072	0.333	1.523
34.096	0.147	0.283	0.283	0.421	0.072	0.333	1.539
36.227	0.138	0.283	0.283	0.447	0.072	0.333	1.555
38.358	0.130	0.283	0.283	0.472	0.072	0.333	1.573
40.489	0.123	0.283	0.283	0.498	0.072	0.333	1.592
42.620	0.117	0.283	0.283	0.523	0.072	0.333	1.612

Advanced Statistical Tools

Constant Wear

Bawani Ho
Acme
2007-Mar-05 : 16:03:46

Applet Introduction

Applet Details	
Applet Title	ConstWear
Description	Constant Wear
Objective	To calculate the Constant Wear properties of failure parts
Abstract	Constant Wear is useful for practioners to calculate the failure rates.
Team Leader	Bawani Ho
Commencement Date	21-Aug-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	ConstWear
Team Members	**1** IR00112 Shazlee Lakuan

Constant Wear Phase

Assuming the part is in the constant-wear phase	
Unit of item	part
Unit of time	hr

A part fails at the rate of lambda (l) where	
Lamda	0.000002 part/hr

The Mean Time Between Failure (MTBF) is therefore	
MTBF	500000 hr

If a part is used for a time (t) where	
t	500 hr

The expected number of parts to fail at time t is	
Lamda(t)	0.001 part

The reliability (R) at time t, R(t) is exp(lt)	
R(t)	0.999

Advanced Statistical Tools

Wear Out

Bawani Ho
Acme
2007-Mar-05 : 16:06:25

Applet Introduction

Applet Details	
Applet Title	WearOut
Description	Wear Out
Objective	To provide a template to calculate the Wear Out rates of failure parts
Abstract	Wear Out is a useful template for engineers to use when calculating failure rates in the Wear Out phase.
Team Leader	Bawani Ho
Commencement Date	21-Aug-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	WearOut
Team Members	**1** IR0025 Fauzi Rozita

Wear Out Phase

Assuming the part is in the wear-out phase	
Unit of item	part
Unit of time	hr

A part (p) fails at the rate of the normal distribution with	
mean	5 hr
stdev	1.4 hr

If a part is used for a time (t) where	
t	300 hr

The log-normal standard deviate (u) is	
u	0.503

The Failure Rate	
F(u)	0.691

The reliability (R) at time t, R(t) is exp(lt)	
R(t)	0.309

The Mean Time Between Failure (MTBF) is therefore	
MTBF	395.44 hr

Advanced Statistical Tools

Weibull Distributions

Bawani Ho
Acme
2007-Mar-05 : 16:07:15

Applet Introduction

Applet Details	
Applet Title	Weibull
Description	Weibull Distributions
Objective	To demonstrate different Weibull Distributions using different parameters
Abstract	Weibull Distributions are useful for engineers to understand the various types of distributions.
Team Leader	Bawani Ho
Commencement Date	21-Aug-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	Weibull
Team Members	

1	IR0021	Eswari Raman
2	IR0008	Badrulhisham Fauzi

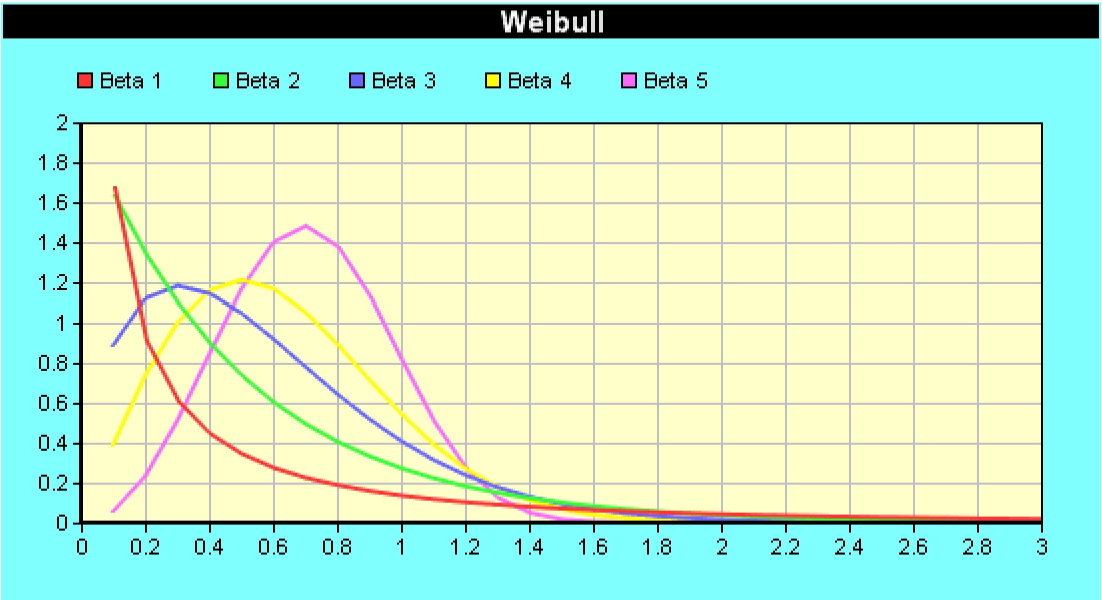
Weibull

Data

Alpha	2	Beta 3	1.5
Beta 1	0.5	Beta 4	2
Beta 2	1	Beta 5	3

Weibull Graph

Display ☑ Beta 1 ☑ Beta 2 ☑ Beta 3 ☑ Beta 4 ☑ Beta 5



Calculations

Alpha	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5
0.1	1.680	1.637	0.891	0.392	0.060
0.2	0.914	1.341	1.122	0.738	0.236
0.3	0.611	1.098	1.183	1.002	0.512
0.4	0.446	0.899	1.144	1.162	0.845
0.5	0.344	0.736	1.046	1.213	1.168
0.6	0.274	0.602	0.917	1.168	1.402
0.7	0.224	0.493	0.778	1.051	1.481
0.8	0.187	0.404	0.641	0.890	1.379
0.9	0.158	0.331	0.516	0.712	1.131
1.0	0.135	0.271	0.406	0.541	0.812
1.1	0.117	0.222	0.313	0.391	0.507
1.2	0.102	0.181	0.237	0.269	0.273
1.3	0.090	0.149	0.176	0.177	0.125
1.4	0.079	0.122	0.129	0.111	0.049
1.5	0.070	0.100	0.093	0.067	0.016
1.6	0.063	0.082	0.066	0.038	0.004
1.7	0.057	0.067	0.046	0.021	0.001

1.8	0.051	0.055	0.032	0.011	0.000
1.9	0.046	0.045	0.022	0.006	0.000
2.0	0.042	0.037	0.015	0.003	0.000
2.1	0.038	0.030	0.010	0.001	0.000
2.2	0.035	0.025	0.007	0.001	0.000
2.3	0.032	0.020	0.004	0.000	0.000
2.4	0.029	0.016	0.003	0.000	0.000
2.5	0.027	0.013	0.002	0.000	0.000
2.6	0.025	0.011	0.001	0.000	0.000
2.7	0.023	0.009	0.001	0.000	0.000
2.8	0.021	0.007	0.000	0.000	0.000
2.9	0.019	0.006	0.000	0.000	0.000
3.0	0.018	0.005	0.000	0.000	0.000

Advanced Statistical Tools

Failure Pattern

Bawani Ho
Acme
2007-Mar-05 : 16:11:52

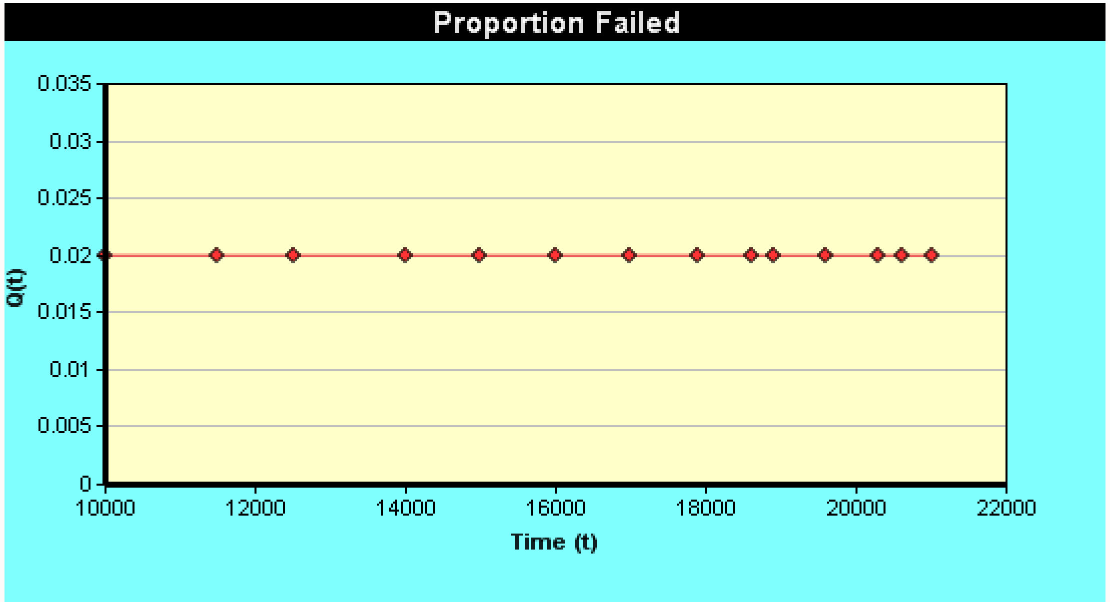
Applet Introduction

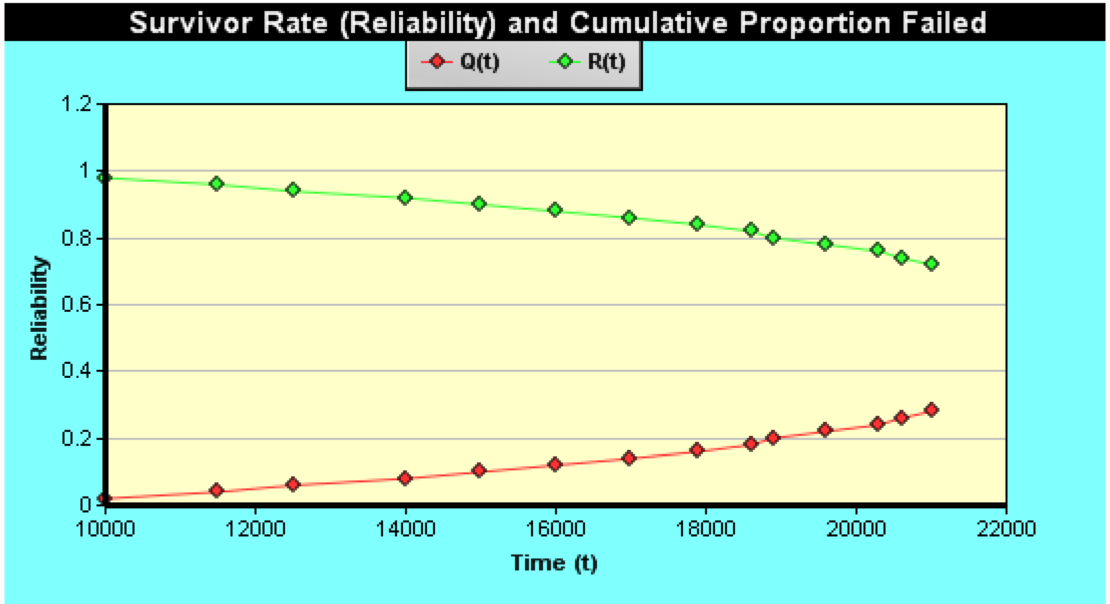
Applet Details	
Applet Title	FailPat
Description	Failure Pattern
Objective	Failure Pattern is used to identify the type of failure pattern
Abstract	Failure patters are sometimes need to engineer better products.
Team Leader	Bawani Ho
Commencement Date	12-Nov-2005
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	FailPat
Team Members	**1** IR0090 Palani Vellu

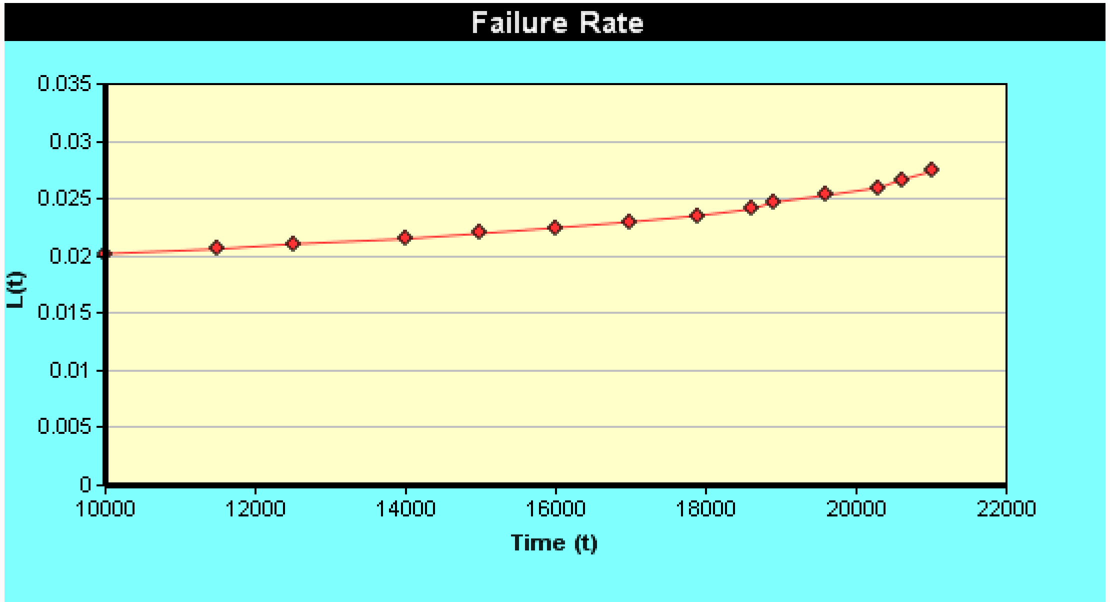
Dominant Failure Pattern

Name of the Study	Test
No. of Observation	50

No.	Time (t)	Fail	F(t)	Cum Fail	Q(t)	Surv	R(t)	l(t)	Ln(t)	Ln(Ln(1/(1-p)))
1	10000	1	0.020	1	0.020	49	0.980	0.020	9.210	-3.902
2	11500	1	0.020	2	0.040	48	0.960	0.021	9.350	-3.199
3	12500	1	0.020	3	0.060	47	0.940	0.021	9.433	-2.783
4	14000	1	0.020	4	0.080	46	0.920	0.022	9.547	-2.484
5	15000	1	0.020	5	0.100	45	0.900	0.022	9.616	-2.250
6	16000	1	0.020	6	0.120	44	0.880	0.022	9.680	-2.057
7	17000	1	0.020	7	0.140	43	0.860	0.023	9.741	-1.892
8	17900	1	0.020	8	0.160	42	0.840	0.024	9.793	-1.747
9	18600	1	0.020	9	0.180	41	0.820	0.024	9.831	-1.617
10	18900	1	0.020	10	0.200	40	0.800	0.025	9.847	-1.500
11	19600	1	0.020	11	0.220	39	0.780	0.025	9.883	-1.392
12	20300	1	0.020	12	0.240	38	0.760	0.026	9.918	-1.293
13	20600	1	0.020	13	0.260	37	0.740	0.027	9.933	-1.200
14	21000	1	0.020	14	0.280	36	0.720	0.027	9.952	-1.113

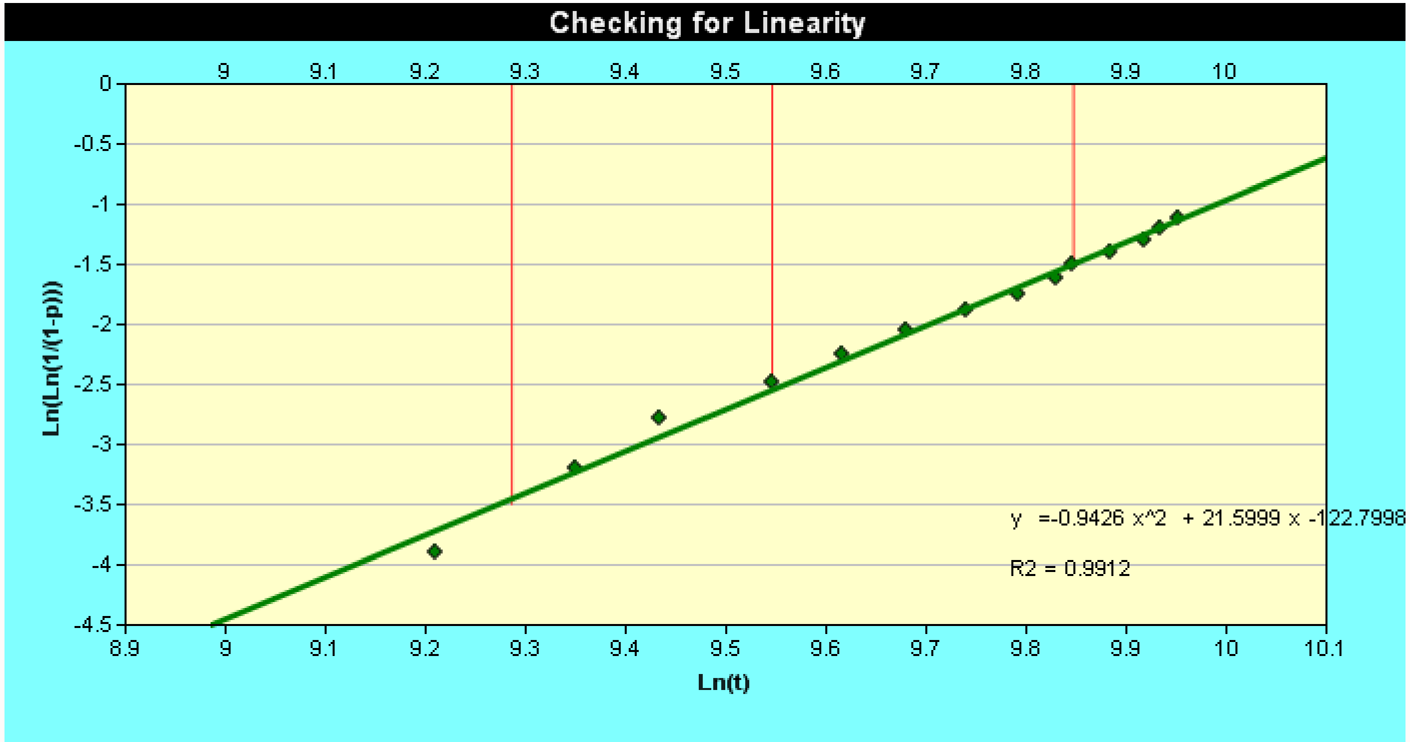

Proportion Failed
Q(t)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
10000
12000
14000
16000
18000
20000
22000
Time (t)


Survivor Rate (Reliability) and Cumulative Proportion Failed
Q(t)
R(t)
Reliability
1.2
1
0.8
0.6
0.4
0.2
0
10000
12000
14000
16000
18000
20000
22000
Time (t)



Calculations (Step 1)		
Correlation	R^2	0.991
Slope	Beta (b)	3.484
Intercept	Alpha (a)	-35.811

Checking for Curvature (Step 1)		
Time (t)	Ln(t)	Ln(Ln(1/(1-p)))
10788	9.286	-3.500
13989	9.546	-2.500
18905	9.847	-1.500



Predictions (Step 1)					Shape factor Beta (b)	3.484	Wear Out
% Failure	**Time (t)**	**P(Fail)**	**Ln(t)**	**Ln(Ln(1/(1-p)))**	**Minimum life**	4817.767	(i.e. 0% of population fails)
10.000	15249.706	0.100	9.632	-2.250	**B10 Maintenance replacement life**	15249.706	(i.e. 10% of population fails)
50.000	26186.849	0.500	10.173	-0.367	**Mean life**	26186.849	(i.e. 50% of population fails)
63.200	29088.953	0.632	10.278	0.000	**Characteristic life Alpha (a)**	29088.953	(i.e. 63.2% of population fails)

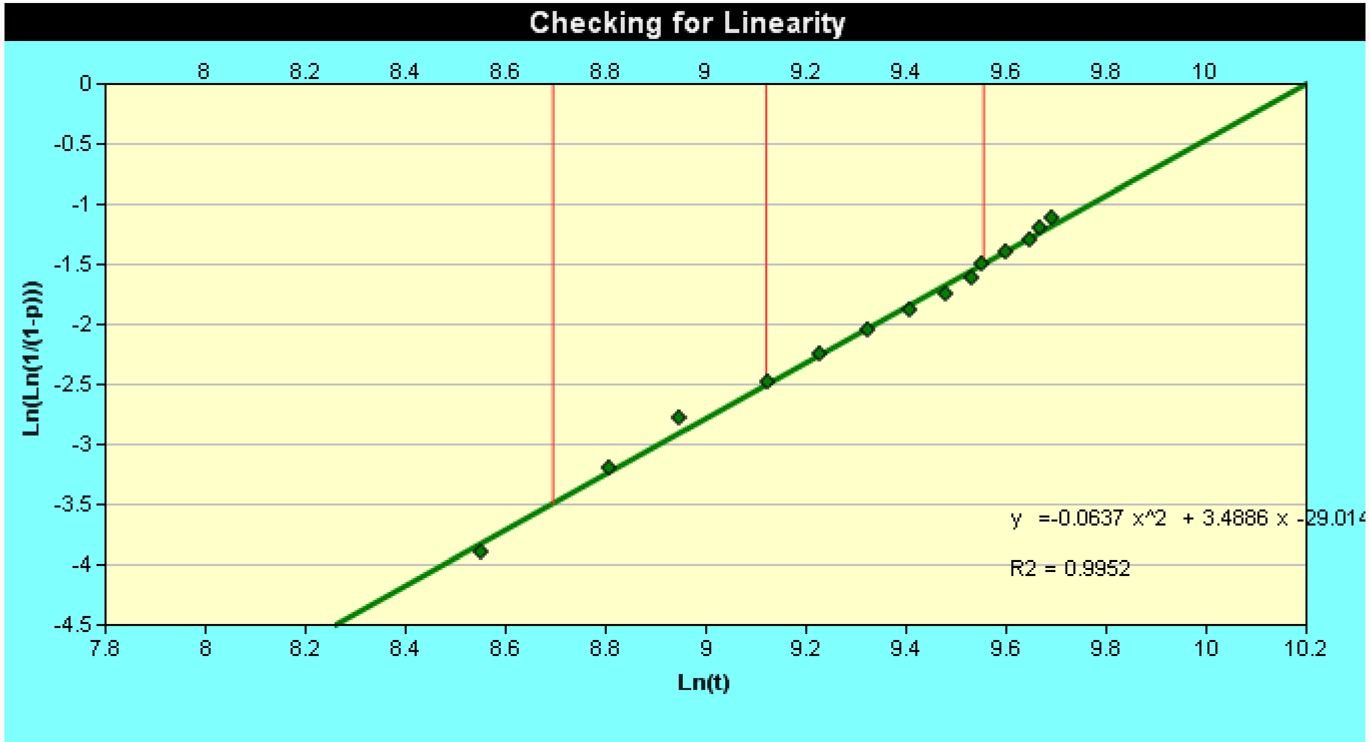
A correction is needed. Proceed to next section.

Iteration 2

Corrected Data (Step 2)										
No.	Time (t)	Fail	F(t)	Cum Fail	Q(t)	Surv	R(t)	l(t)	Ln(t)	Ln(Ln(1/(1-p)))
1	5182	1	0.020	1	0	49	0.980	0.020	8.553	-3.902
2	6682	1	0.020	2	0	48	0.960	0.021	8.807	-3.199
3	7682	1	0.020	3	0	47	0.940	0.021	8.947	-2.783
4	9182	1	0.020	4	0	46	0.920	0.022	9.125	-2.484
5	10182	1	0.020	5	0	45	0.900	0.022	9.228	-2.250
6	11182	1	0.020	6	0	44	0.880	0.022	9.322	-2.057
7	12182	1	0.020	7	0	43	0.860	0.023	9.408	-1.892
8	13082	1	0.020	8	0	42	0.840	0.024	9.479	-1.747
9	13782	1	0.020	9	0	41	0.820	0.024	9.531	-1.617
10	14082	1	0.020	10	0	40	0.800	0.025	9.553	-1.500
11	14782	1	0.020	11	0	39	0.780	0.025	9.601	-1.392
12	15482	1	0.020	12	0	38	0.760	0.026	9.647	-1.293
13	15782	1	0.020	13	0	37	0.740	0.027	9.667	-1.200
14	16182	1	0.020	14	0	36	0.720	0.027	9.692	-1.113

Calculations (Step 2)		
Correlation	R^2	0.995
Slope	Beta (b)	2.32
Intercept	Alpha (a)	-23.663

Checking for Curvature (Step 2)		
Time (t)	Ln(t)	Ln(Ln(1/(1-p)))
5971	8.695	-3.500
9133	9.120	-2.500
14111	9.555	-1.500



Corrected Predicitons				
% Failure	Time (t)	P(Fail)	Ln(t)	Ln(Ln(1/(1-p)))
10.000	10208.667	0.100	9.231	-2.250
50.000	22996.687	0.500	10.043	-0.367
63.200	26929.152	0.632	10.201	0.000

Shape factor Beta (b)	3.484	2.320	Wear Out
Minimum life	4817.767	5285.359	(i.e. 0% of population fails)
B10 Maintenance replacement life	15249.706	15026.434	(i.e. 10% of population fails)
Mean life	26186.849	27814.454	(i.e. 50% of population fails)
Characteristic life Alpha (a)	29088.953	31746.919	(i.e. 63.2% of population fails)

Advanced Statistical Tools

Accelerated Test

Bawani Ho
Acme
2007-Mar-05 : 16:11:13

Applet Introduction

Applet Details	
Applet Title	Accelerated Test
Description	Accelerated Test
Objective	The objective of Accelerated Test is to provides a range of tools to help engineers improve the reliability of products by determining the possible failure ponits.
Abstract	Accelerated Tests are an important aspect that needs to be understood for improving product reliability.
Team Leader	Bawani Ho
Commencement Date	28-Oct-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	
Team Members	***No Team Members are selected.***

Accelerated Test

Mode Of Selection : Normal Notation

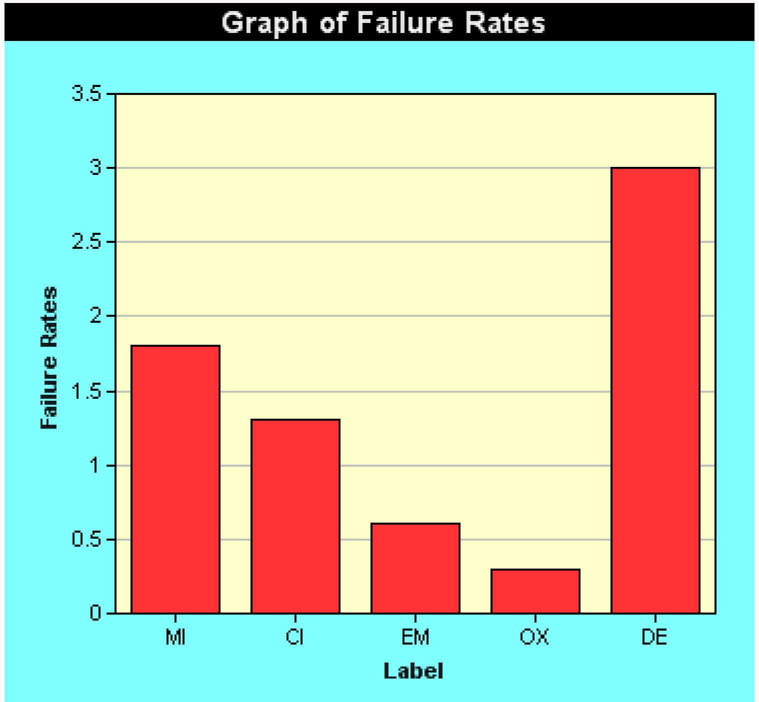
Test Failures

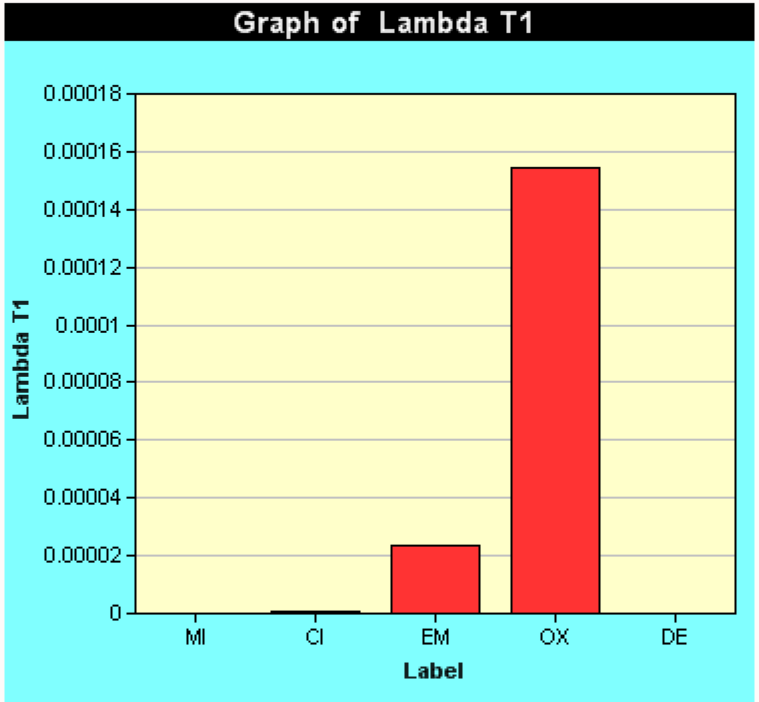
Number of parts put to test	n	1000 pcs
Duration of test	d	1000 hr
Operating temperature	T1	55 °C = 328 K
Temperature of test	T2	125 °C = 398 K
Boltzman Constant	k	8.6 E-05 eV/ K

Failure types	Label	Failure Rate	Unit	Number	λ_{T2}	Φ_x	λ_{T1}
Metal migration	MI	18.00E-01	eV/ K	0	00.00E+00	00.00E+00	00.00E+00
Charge Injection	CI	13.00E-01	eV/ K	2	00.00E+00	00.00E+00	00.00E+00
Electron Migration	EM	60.00E-02	eV/ K	1	00.00E+00	20.00E-03	00.00E+00
Oxide	OX	30.00E-02	eV/ K	1	00.00E+00	15.00E-02	00.00E+00
Dielectric	DE	30.00E-01	eV/ K	0	00.00E+00	00.00E+00	00.00E+00

Combined failure rate is : 1.790028E-007 pcs / hr

Graph of Failure Analysis


Graph of Failure Rates
Failure Rates
3.5
3
2.5
2
1.5
1
0.5
0
MI
CI
EM
OX
DE
Label


Graph of Lambda T1
Lambda T1
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
MI
CI
EM
OX
DE
Label

Advanced Statistical Tools

Reliability Studies

Badrulhisham Fauzi
Acme
2007-Mar-05 : 16:14:54

Applet Introduction

Applet Details	
Applet Title	RelStudies
Description	Reliability Studies
Objective	The objective of Reliability Studies is to provides a range of tools to help engineers improve the reliability of products
Abstract	Reliability Studies are an important aspect that needs to be understood for improving product reliability.
Team Leader	Badrulhisham Fauzi
Commencement Date	15-Jul-2006
Expected Completion Date	
Completion Date	
Status	Not Completed
Team Name	RelStudies
Team Members	**1** IR0020 Farida Sulaiman

Constant Wear Phase

Assuming the part is in the constant-wear phase	
Unit of item	part kk
Unit of time	hr

A part fails at the rate of lambda (l) where	
Lamda	0.000002 part kk/hr

The Mean Time Between Failure (MTBF) is therefore	
MTBF	500000 hr

If a part is used for a time (t) where	
t	500 hr

The expected number of parts to fail at time t is	
Lamda(t)	0.001 part kk

The reliability (R) at time t, R(t) is exp(lt)	
R(t)	0.999

Wear Out Phase

Assuming the part is in the wear-out phase	
Unit of item	part
Unit of time	hr

A part (p) fails at the rate of the normal distribution with	
mean	5 hr
stdev	1.4 hr

If a part is used for a time (t) where	
t	300 hr

The log-normal standard deviate (u) is	
u	0.503

The Failure Rate	
F(u)	0.691

The reliability (R) at time t, R(t) is exp(lt)	
R(t)	0.309

The Mean Time Between Failure (MTBF) is therefore	
MTBF	395.44 hr

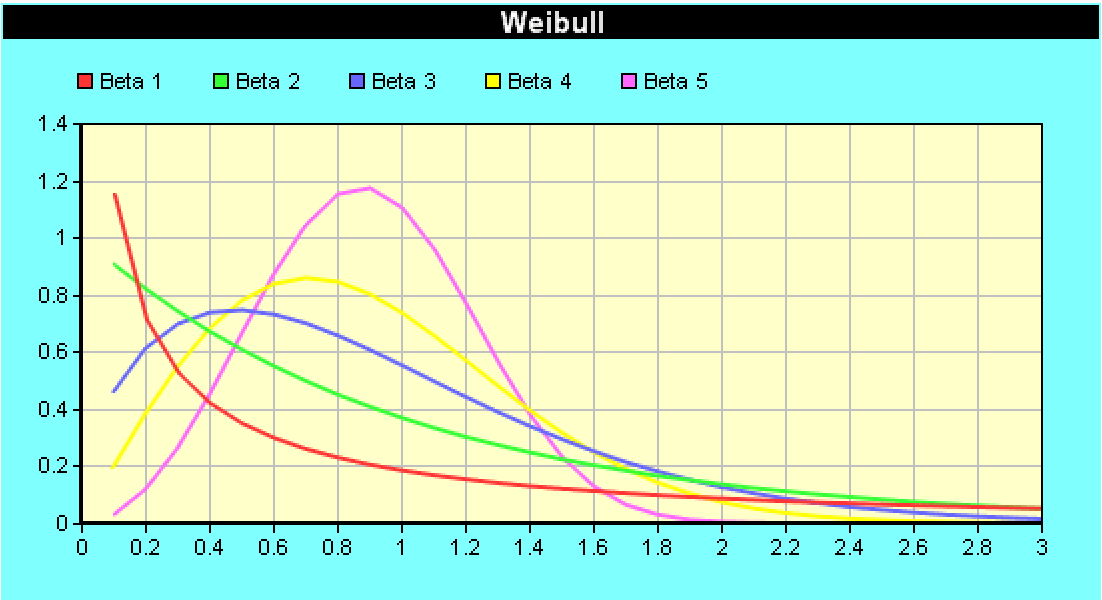
Weibull

Data

Alpha	1	**Beta 3**	1.5
Beta 1	0.5	**Beta 4**	2
Beta 2	1	**Beta 5**	3

Weibull Graph

Display ☑ **Beta 1** ☑ **Beta 2** ☑ **Beta 3** ☑ **Beta 4** ☑ **Beta 5**



Calculations

Alpha	Beta 1	Beta 2	Beta 3	Beta 4	Beta 5
0.1	1.152	0.905	0.460	0.198	0.030
0.2	0.715	0.819	0.613	0.384	0.119
0.3	0.528	0.741	0.697	0.548	0.263
0.4	0.420	0.670	0.737	0.682	0.450
0.5	0.349	0.607	0.745	0.779	0.662
0.6	0.298	0.549	0.730	0.837	0.870
0.7	0.259	0.497	0.699	0.858	1.043
0.8	0.229	0.449	0.656	0.844	1.151
0.9	0.204	0.407	0.606	0.801	1.172
1.0	0.184	0.368	0.552	0.736	1.104
1.1	0.167	0.333	0.496	0.656	0.959
1.2	0.153	0.301	0.441	0.569	0.767
1.3	0.140	0.273	0.388	0.480	0.563
1.4	0.129	0.247	0.339	0.394	0.378
1.5	0.120	0.223	0.293	0.316	0.231
1.6	0.112	0.202	0.251	0.247	0.128
1.7	0.104	0.183	0.213	0.189	0.064

1.8	0.097	0.165	0.180	0.141	0.029
1.9	0.091	0.150	0.151	0.103	0.011
2.0	0.086	0.135	0.125	0.073	0.004
2.1	0.081	0.122	0.104	0.051	0.001
2.2	0.076	0.111	0.085	0.035	0.000
2.3	0.072	0.100	0.070	0.023	0.000
2.4	0.069	0.091	0.056	0.015	0.000
2.5	0.065	0.082	0.046	0.010	0.000
2.6	0.062	0.074	0.037	0.006	0.000
2.7	0.059	0.067	0.029	0.004	0.000
2.8	0.056	0.061	0.023	0.002	0.000
2.9	0.053	0.055	0.018	0.001	0.000
3.0	0.051	0.050	0.014	0.001	0.000

Accelerated Test

Mode Of Selection : Normal Notation

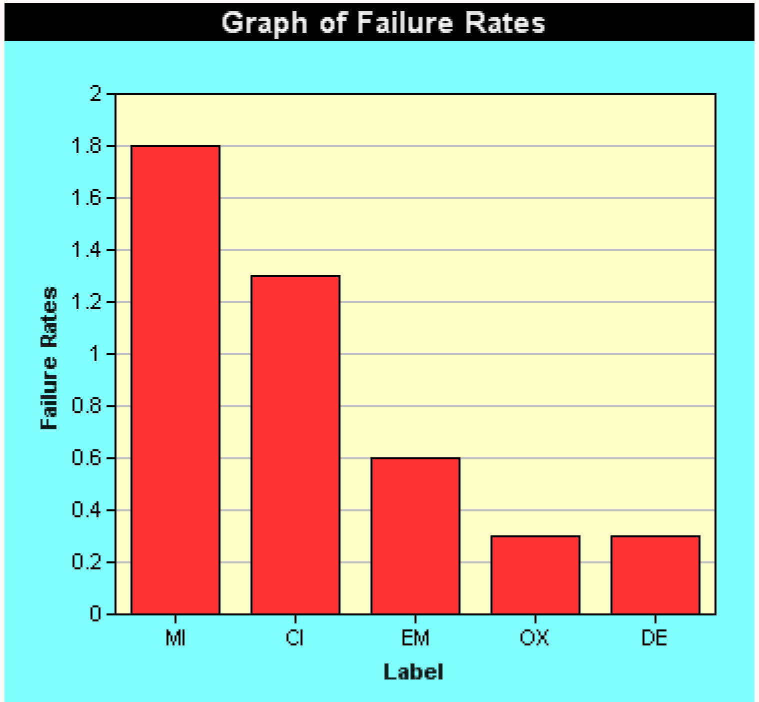
Test Failures

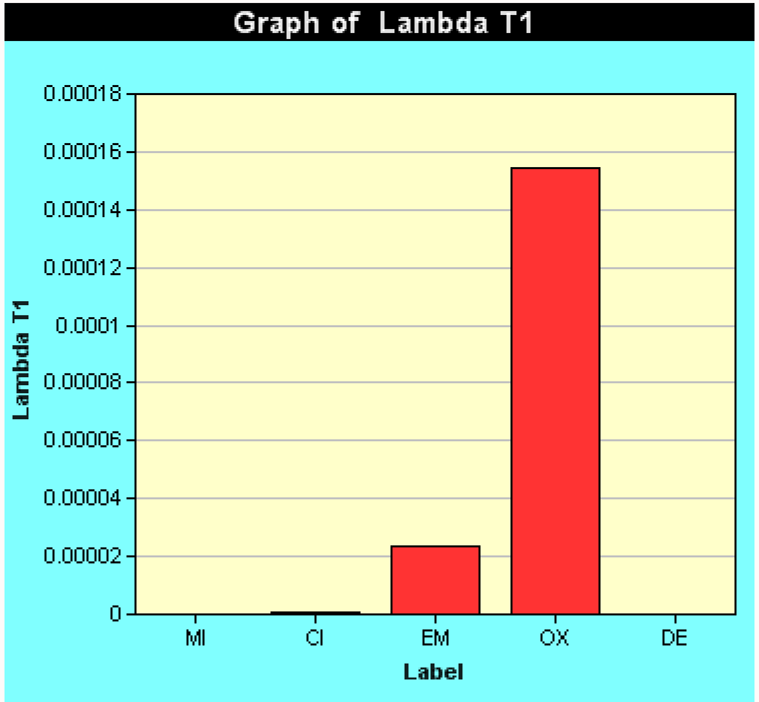
Number of parts put to test	n	1000 pcs
Duration of test	d	1000 hr
Operating temperature	T1	55 °C = 328 K
Temperature of test	T2	125 °C = 398 K
Boltzman Constant	k	8.6 E-05 eV/ K

Failure types	Label	Failure Rate	Unit	Number	λ_{T2}	Φ_{x}	λ_{T1}
Metal migration	MI	18.00E-01	eV/ K	0	00.00E+00	00.00E+00	00.00E+00
Charge Injection	CI	13.00E-01	eV/ K	2	00.00E+00	00.00E+00	00.00E+00
Electron Migration	EM	60.00E-02	eV/ K	1	00.00E+00	20.00E-03	00.00E+00
Oxide	OX	30.00E-02	eV/ K	1	00.00E+00	15.00E-02	00.00E+00
Dielectric	DE	30.00E-02	eV/ K	0	00.00E+00	15.00E-02	00.00E+00

Combined failure rate is : **1.790028E-007 pcs / hr**

Graph of Failure Analysis

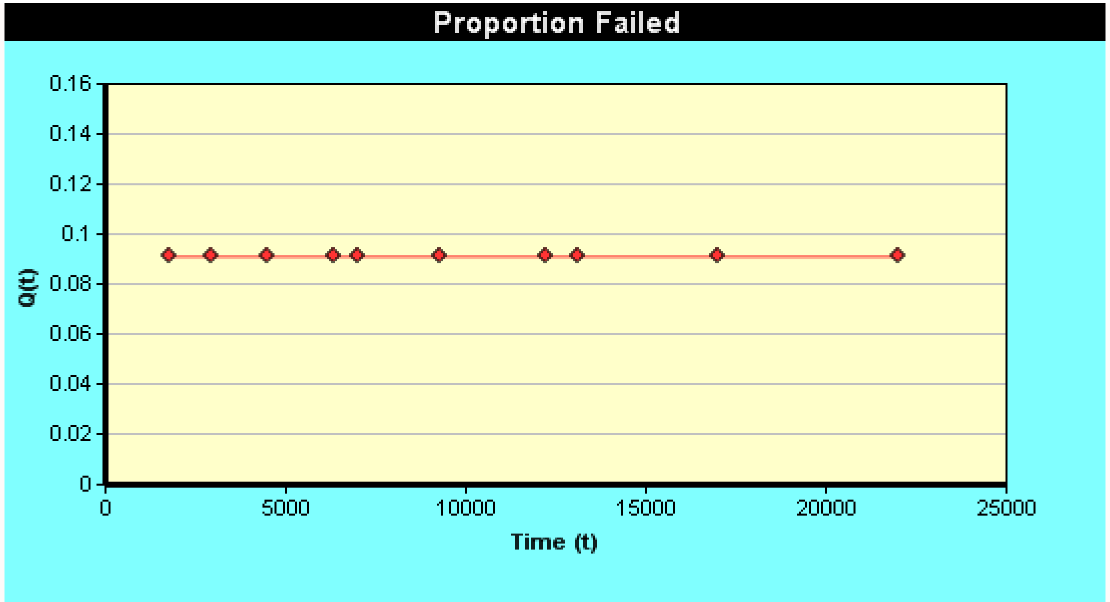

Graph of Failure Rates
Failure Rates
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
MI
CI
EM
OX
DE
Label

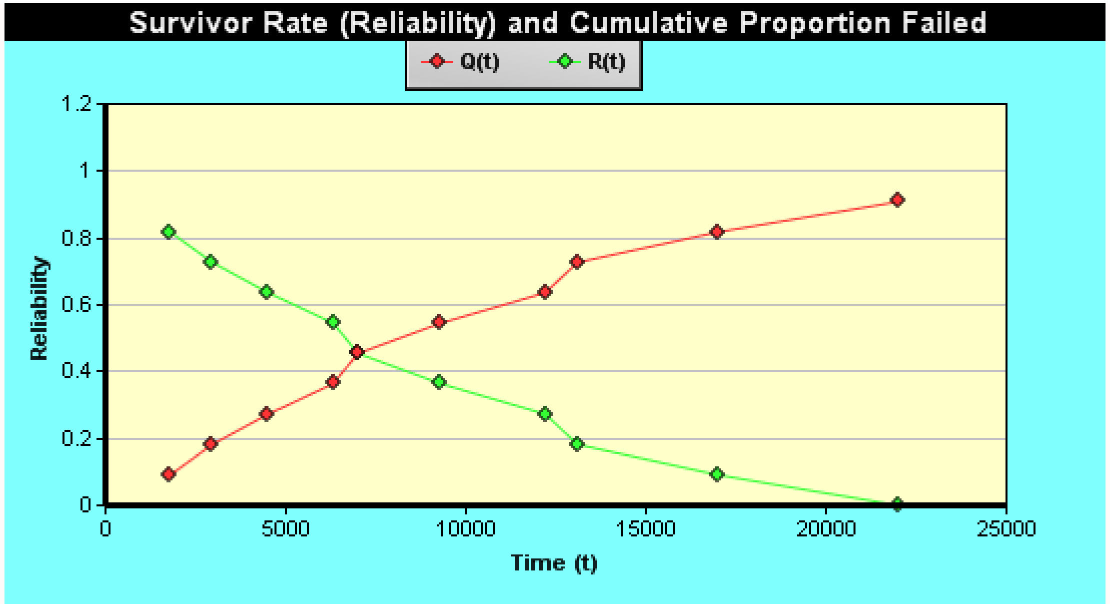

Graph of Lambda T1
Lambda T1
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
MI
CI
EM
OX
DE
Label

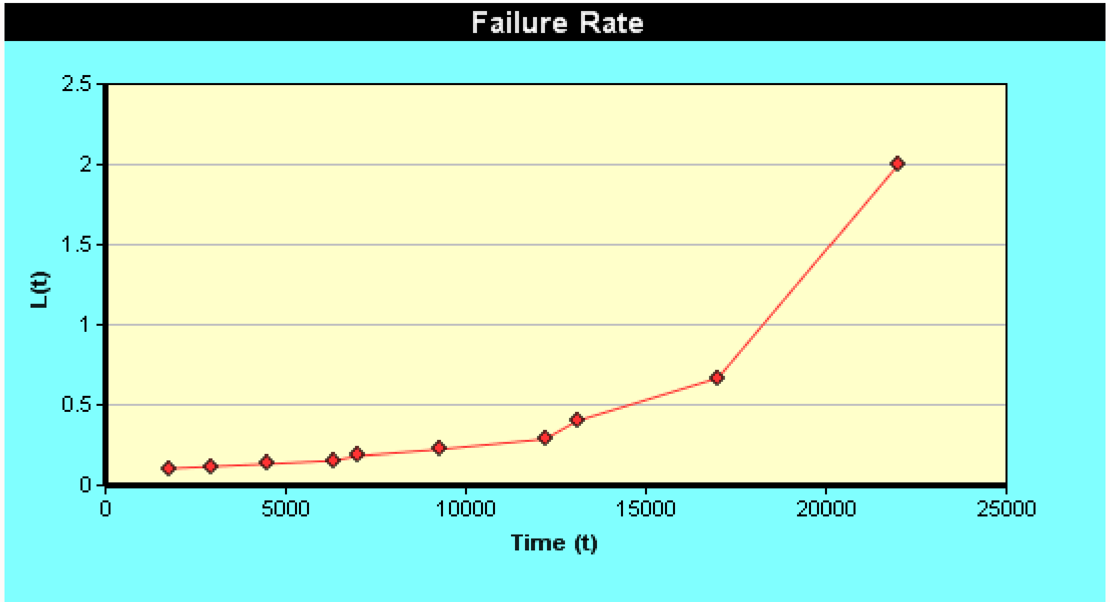
Dominant Failure Pattern

Name of the Study	Test
No. of Observation	10

No.	Time (t)	Fail	F(t)	Cum Fail	Q(t)	Surv	R(t)	l(t)	Ln(t)	Ln(Ln(1/(1-p)))
1	1800	1	0.091	1	0.091	9	0.818	0.105	7.496	-2.351
2	2970	1	0.091	2	0.182	8	0.727	0.118	7.996	-1.606
3	4520	1	0.091	3	0.273	7	0.636	0.133	8.416	-1.144
4	6310	1	0.091	4	0.364	6	0.545	0.154	8.750	-0.794
5	7000	1	0.091	5	0.455	5	0.455	0.182	8.854	-0.501
6	9300	1	0.091	6	0.545	4	0.364	0.222	9.138	-0.238
7	12200	1	0.091	7	0.636	3	0.273	0.286	9.409	0.012
8	13100	1	0.091	8	0.727	2	0.182	0.400	9.480	0.262
9	17000	1	0.091	9	0.818	1	0.091	0.667	9.741	0.533
10	22000	1	0.091	10	0.909	0	0.000	2.000	9.999	0.875

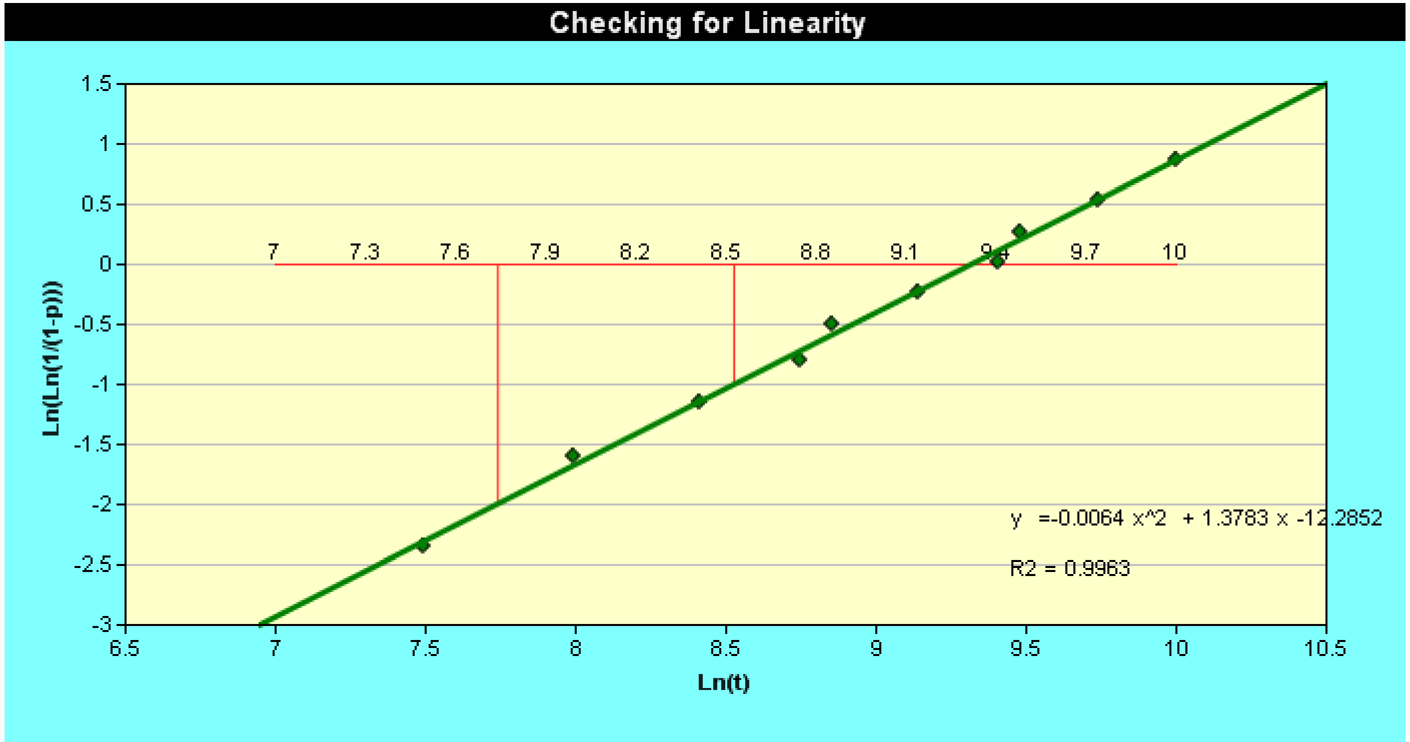

Proportion Failed
Q(t)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
5000
10000
15000
20000
25000
Time (t)


Survivor Rate (Reliability) and Cumulative Proportion Failed
Q(t)
R(t)
Reliability
1.2
1
0.8
0.6
0.4
0.2
0
0
5000
10000
15000
20000
25000
Time (t)



Calculations (Step 1)		
Correlation	R^2	0.996
Slope	Beta (b)	1.266
Intercept	Alpha (a)	-11.796

Checking for Curvature (Step 1)		
Time (t)	Ln(t)	Ln(Ln(1/(1-p)))
2302	7.741	-2.000
5046	8.526	-1.000
11133	9.318	0.000



Predictions (Step 1)				
% Failure	Time (t)	P(Fail)	Ln(t)	Ln(Ln(1/(1-p)))
10.000	1884.206	0.100	7.541	-2.250
50.000	8346.091	0.500	9.030	-0.367
63.200	11146.079	0.632	9.319	0.000

Shape factor Beta (b)	1.266	Wear Out
Minimum life	48.024	(i.e. 0% of population fails)
B10 Maintenance replacement life	1884.206	(i.e. 10% of population fails)
Mean life	8346.091	(i.e. 50% of population fails)
Characteristic life Alpha (a)	11146.079	(i.e. 63.2% of population fails)

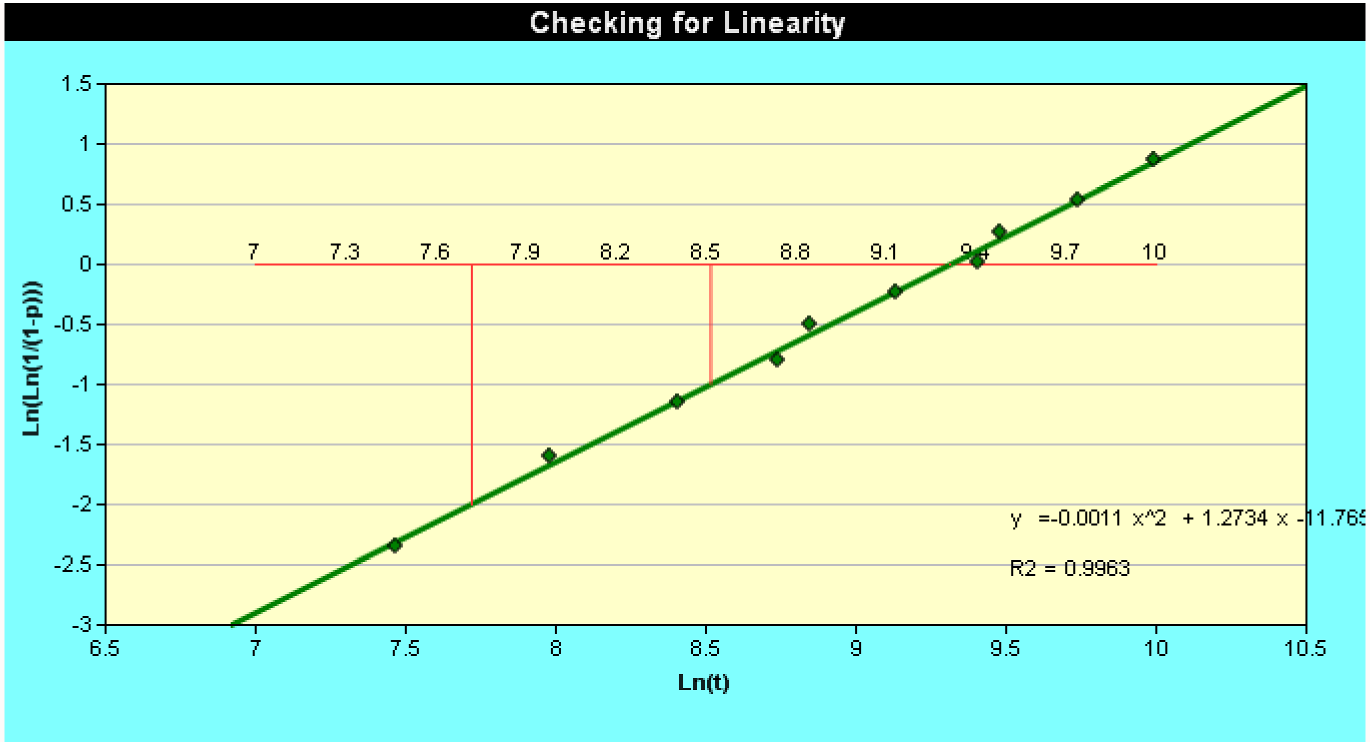
A correction is not needed.

Iteration 2

Corrected Data (Step 2)										
No.	**Time (t)**	**Fail**	**F(t)**	**Cum Fail**	**Q(t)**	**Surv**	**R(t)**	**I(t)**	**Ln(t)**	**Ln(Ln(1/(1-p)))**
1	1752	1	0.091	1	0	9	0.818	0.105	7.468	-2.351
2	2922	1	0.091	2	0	8	0.727	0.118	7.980	-1.606
3	4472	1	0.091	3	0	7	0.636	0.133	8.406	-1.144
4	6262	1	0.091	4	0	6	0.545	0.154	8.742	-0.794
5	6952	1	0.091	5	0	5	0.455	0.182	8.847	-0.501
6	9252	1	0.091	6	1	4	0.364	0.222	9.133	-0.238
7	12152	1	0.091	7	1	3	0.273	0.286	9.405	0.012
8	13052	1	0.091	8	1	2	0.182	0.400	9.477	0.262
9	16952	1	0.091	9	1	1	0.091	0.667	9.738	0.533
10	21952	1	0.091	10	1	0	0.000	2.000	9.997	0.875

Calculations (Step 2)		
Correlation	**R^2**	0.996
Slope	**Beta (b)**	1.254
Intercept	**Alpha (a)**	-11.682

Checking for Curvature (Step 2)		
Time (t)	**Ln(t)**	**Ln(Ln(1/(1-p)))**
2253	7.720	-2.000
4996	8.516	-1.000
11090	9.314	0.000



Corrected Predicitons				
% Failure	Time (t)	P(Fail)	Ln(t)	Ln(Ln(1/(1-p)))
10.000	1844.365	0.100	7.520	-2.250
50.000	8282.057	0.500	9.022	-0.367
63.200	11089.989	0.632	9.314	0.000

Shape factor Beta (b)	1.266	1.254	Wear Out
Minimum life	48.024	56.273	(i.e. 0% of population fails)
B10 Maintenance replacement life	1884.206	1892.389	(i.e. 10% of population fails)
Mean life	8346.091	8330.081	(i.e. 50% of population fails)
Characteristic life Alpha (a)	11146.079	11138.013	(i.e. 63.2% of population fails)