

Design of Truncated Life Test Sampling Plans Using Quantile Life under the Inverted Weibull Distribution

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Abstract

Acceptance sampling based on truncated life tests plays a vital role in ensuring product quality when complete lifetime testing is not feasible. This paper presents an efficient approach of designing single acceptance life test sampling plans using the Inverted Weibull Distribution (IWD). The underlying life distribution i.e., IWD is best suited for modeling failure data with a monotone decreasing hazard rate, commonly observed in early-life failures. The study addresses both producer's risk (α) and consumer's risk (β). Binomial distribution is adopted to construct sampling plans based on the 25th and 50th percentiles (quantile life) under Type-I censoring (time truncation). The paper employs a two-point decision approach to determine the minimum sample size (n) and acceptance number (c) required to meet specified risk constraints and within a pre-specified time. Using R 3.6.1, tables are generated for various shape parameters of the IWD, enabling practitioners to select optimal sampling plans under different conditions. A practical demonstration is included using real-world dataset. The methodology enhances decision-making efficiency by reducing inspection costs, making it highly suitable for industrial applications involving early-life failures.

Keywords: Truncated Life Test Sampling; Binomial Distribution; Quantile Life; Reliability Analysis.

1. Introduction

Quality control is classified into process control and product control. Process control focuses on preventing defects during production, whereas product control evaluates finished products through inspection and acceptance sampling. For products whose quality is measured in terms of lifetime, complete life testing is often impractical because it requires considerable time and cost. In truncated life testing the experiment is terminated at a predetermined time which reduces testing duration and inspection cost while enabling timely decisions regarding product acceptance. In acceptance sampling, the sampling plan is generally designed to control the risks associated with incorrect decisions, particularly the product's risk of rejecting a good-quality lot and the consumer's risk of accepting a poor-quality lot.

Lifetime-based acceptance sampling plans have often been developed using the mean lifetime. Lifetime distribution is frequently skewed, and the mean may not adequately represent the reliability characteristics of a product, particularly its early life performance. Quality-based lifetime measures i.e., median or a specified lower percentile of lifetime, have received increasing attention in reliability analysis and acceptance sampling. A quantile lifetime provides a direct measure of the time by which a specified proportion of products are expected to fail. Therefore, it provides a more meaningful basis for quality assessment under truncated life testing.

In this study, a binomial acceptance sampling plan is developed for truncated life testing when the lifetime of a product follows the Inverted Weibull Distribution (IWD). The proposed plan is formulated using a specified quantile lifetime as the quality criterion, with the objective of determining an appropriate sample size and acceptance number while controlling the producer's and consumer's risks.

Inverted Weibull Distribution (IWD): Research and Applications

The IWD is suitable for modelling decreasing hazard-rates, where the failure rate is higher at the early stage and decreases over time. Also, IWD is right-skewed, making it suitable for positively skewed lifetime data in reliability and survival analysis. The distribution and its inferential properties have been investigated by several researchers. **(Erto, 1989)** established the genesis and identification properties of the inverse Weibull lifetime model. **(Keller & Kamath, 1982)** documented decreasing hazard-rate behaviour in field failure of CNC machine tools, providing an important reliability context for models capable of representing such failure patterns. **(Calbria & Pulcini, 1994)** developed Bayesian prediction methods for the IWD, while **(Mohamed A, Sultan, & Safaa, 2003)** studied order statistics and inferential properties of the Inverse Weibull distribution. **(Kundu & Howlader, 2010)** and **(Kim, Lee, & Kang, 2014)** extended Bayesian inference for the IWD to Type-II censored data and non-informative priors; **(Khan & King, 2014)** proposed the Transmuted Inverse Weibull distribution as a flexible alternative for lifetime-data analysis. **(Muhammed & Muhammed, 2019)** investigated point and interval estimation of IWD parameter under random censoring. These studies demonstrate the usefulness of the IWD in modelling and statistical inference for lifetime data.

A related and well-established stream of research concerns percentile-based acceptance sampling plans under truncated life testing. **(Epstein, 1954)** introduced truncated life testing for the exponential distribution, and subsequent studies extended the approach to several lifetime distributions. **(Kantam, Rosaiah, & Rao, 2001)** developed a plan for the log-logistic distribution, **(Baklizi, 2003)** considered the Pareto distribution, and **(Rosaiah & Kantam, 2005)** studied the inverse Rayleigh distribution. **(Balakrishnan, Leiva, & Lopez, 2007)** developed plans based on the generalized Birnbaum-Saunders distribution, while **(Lio, Tsai, & Wu, 2010)** considered Burr Type-XII percentiles. **(Aslam & Jun, 2009)** developed a truncated life test acceptance sampling plan for the Weibull distribution, **(Aslam, Kundu, & Ahmad, 2010)** extended the methodology to the generalized exponential distribution. Collectively, these studies established the applicability of percentile-based acceptance sampling for evaluating product quality under truncated life testing.

More specifically, researchers have subsequently considered median or percentile-based sampling plans for distributions related to the IWD and other decreasing hazard rate lifetime models. **(Singh, Tripathi, & Jun, 2015)** developed truncated life test sampling plans for the generalized inverted exponential distribution while **(Singh & Tripathi, 2017)** developed double and group acceptance sampling plans based on the median lifetime. **(Singh, Singh, & Kaur, 2018)** developed repetitive acceptance sampling plan for truncated life test using inverse Weibull distribution, and **(Al-Nasser & Obeidat, 2020)** proposed an acceptance sampling plan based on the Tsallis q-exponential distribution whereas **(Neena & Jayalakshmi, 2021)** considered percentile-based sampling plans for the exponentiated Fréchet distribution. These studies indicated a continuing interest in extending truncated life test acceptance sampling methodology to flexible lifetime distributions and percentile-based quality measures.

Recent studies have also extended life test acceptance sampling methodology through alternative sampling structures and accelerated testing frameworks. **(Raykundaliya, Christian, & Divecha, 2022)** developed life test acceptance sampling plan for Weibull-distributed products in an export-quality manufacturing contexts. **(Raykundaliya, Christian, & Divecha, 2023)** developed accelerated life testing under constant acceleration using EWMA-based statistics. **(Christian, Raykundaliya, & Divecha, 2023)** incorporate the producer's prior experience via a zero-modified binomial framework for the Weibull distribution. **(Raykundaliya, Christian, & Divecha, 2024)** developed a two-stage life test acceptance sampling plan for Weibull-distributed products using the trinomial distribution, allowing early and later failures to reduce producer's and consumer's risks. **(Raykundaliya, Christian, & Divecha, 2025)** further proposed a two-stage accelerated life test acceptance sampling plan for Weibull-distributed durable products by applying increasing levels of acceleration across

test intervals to obtain quicker inference about product quality while safeguarding both producer and consumer interests.

Despite these development, the literature indicates a methodological gap concerning the development of a binomial truncated life test acceptance sampling plan based directly on a specified quantile lifetime under the Inverted Weibull Distribution. Existing studies have considered the IWD and its extensions mainly from the perspectives of distributional properties, parameter estimation, Bayesian inference, censoring, and related sampling plan. However, a dedicated quantile-based binomial acceptance sampling for the IWD that determines the sample size and acceptance criterion while explicitly controlling producer's and consumer's risks has not been sufficiently addressed. The present study aims to fill this gap by developing such a plan under truncated life testing.

This paper develops a quantile-based life test acceptance sampling plan for the Inverted Weibull Distribution (IWD) using a binomial model to balance both producer's and consumer's risks under truncated life testing. **Section 2** presents the Inverted Weibull Distribution (IWD) and its PDF, CDF, and quantile function. It explains how to calculate the failure probability based on a given quantile life (e.g., 25th or 50th percentile), and how this value is used to parameterize the binomial acceptance model. **Section 3** presents a binomial-based single acceptance sampling plan under truncated life testing, using the IWD quantile function to determine the required minimum sample size and acceptance number for specified producer's and consumer's risks. **Section 4** defines the key sampling plan parameters, including the shape parameter, quantile level, risks, truncation time, test severity and quality ratios, sample size, and acceptance number, along with guidelines for their practical determination. **Section 5** discusses observations derived from the generated sampling plan tables. **Section 6** provides a simulation-based example demonstrating the practical application of the proposed sampling plans. In **Section 7**, a real-life dataset involving failure times of airplane air-conditioning systems is analyzed. Finally, **Section 8** concludes by highlighting that the proposed binomial acceptance sampling plan is effective in balancing both producer's and consumer's risks under truncated life tests for products modelled by the Inverted Weibull Distribution. Plan tables for binomial distributions are generated to support practical decision-making across different reliability levels.

2. Inverted Weibull Distribution

The probability density function (PDF) of the two-parameter Inverted Weibull distribution (IWD), with shape parameter θ and scale parameter σ is defined as:

$$f(t, \theta, \sigma) = \frac{\theta}{\sigma} \left(\frac{\sigma}{t}\right)^{\theta+1} e^{-\left(\frac{\sigma}{t}\right)^{\theta}}; \quad t > 0 \quad \theta > 0 \quad \sigma > 0 \quad (1)$$

The above form is mathematically equivalent to the standard two-parameter Inverted Weibull distribution reported in the literature (Keller & Kamath, 1982); (Khan & King, 2014); (Muhammed & Muhammed, 2019).

The standard form given by (Keller & Kamath, 1982) can be transformed through an appropriated change of variable and parameter notation to obtain the expression in (1). The PDF used in this study is not a modified form of the IWD; rather, it is equivalent algebraic representation with a different parameterization.

The cumulative distribution function (CDF) of Inverted Weibull Distribution is given by

$$F(t) = e^{-\left(\frac{\sigma}{t}\right)^{\theta}}; \quad t > 0 \quad \theta > 0 \quad \sigma > 0 \quad (2)$$

The $100q^{th}$ quantile t_q is defined by:

$$t_q = \sigma [-\log q]^{-\frac{1}{\theta}} \Rightarrow \sigma = \frac{t_q}{b}; \quad \text{where } b = [-\log q]^{-\frac{1}{\theta}}$$

Using this, the failure probability upto time t is:

$$F(t, \delta) = \exp[\log q \cdot \delta^{-\theta}], \text{ where } \delta = \frac{t}{t_q}, \delta_0 = \frac{t}{t_q^0} \quad (3)$$

Since, $F(t, \delta)$ is a decreasing function of δ , it follows that:

$$F(t, \delta) \geq F(t, \delta_0) \Rightarrow t_q \geq t_q^0,$$

Thus, the failure probability p used in equation (3) is expressed as:

$$p = \exp \left[- \left(\frac{\frac{t_q}{t_q^0}}{\delta_0 b} \right)^\theta \right] \quad (4)$$

3. Design of Life Test Sampling Plan under Binomial Distribution

Suppose we have a lot of items under decision for acceptance or rejection whose quality characteristics are lifetime/failure-time of product. Let the specified quantile life and true quantile life of the product be t_q^0 and t_q , the submitted lot will be accepted if $H_0: t_q \geq t_q^0$ holds and rejected if $H_1: t_q < t_q^0$.

Let us consider a lot of size items, where the quality characteristic is the lifetime or failure-time of the units. The decision to accept or reject the lot is based on observing the number of failures within a pre-specified test time. The procedure for designing a life test-based single sampling plan (LSP) using truncation is outlined as follows:

Step: I: Select n items at random from the lot. Let X_i ($i = 1, 2, 3, \dots, n$) be the lifetimes of the items. Place all items under test for a predetermined time t .

Step II: Define an indicator variable I_j as follows:

$$I_j = \begin{cases} 1, & \text{if } X_i \leq t; \quad (i = 1, 2, 3, \dots, n) \\ 0, & \text{elsewhere} \end{cases} \quad (5)$$

Denote total number of items that fail during test time t be d i.e., $d = \sum_{j=1}^n I_j$ (6)

Step: III: The lot is accepted if $d \leq c$, and rejected if $d > c$. The number c is known as the acceptance number. Assume that each item fails independently with probability p during the test time $[0, t]$. Then, d follows a binomial distribution with parameter n and p .

$$\text{Mean} = np$$

$$\text{Variance} = np(1 - p)$$

The probability of accepting the lot is given by the cumulative probability of d under the binomial distribution:

$$L(p) = \sum_{d=0}^c \binom{n}{d} p^d (1 - p)^{n-d} \quad (7)$$

Let α and β denote the producer's and consumer's risk respectively. Let p_1 and p_2 be the failure probabilities corresponding to a good lot and a poor lot, respectively. Then the condition to satisfy both risk are

$$\left. \begin{aligned} L(p_1) &= \sum_{d=0}^c \binom{n}{d} p_1^d (1 - p_1)^{n-d} \geq 1 - \alpha \\ L(p_2) &= \sum_{d=0}^c \binom{n}{d} p_2^d (1 - p_2)^{n-d} \leq \beta \end{aligned} \right\} \quad (8)$$

Under normal Approximation, Eq. (8) can be written as the probability of accepting a good lot is expressed by,

$$P_a(p_1) = \Phi \left(\frac{c - np_1}{\sqrt{np_1(1 - p_1)}} \right) \geq 1 - \alpha$$

$$P_a(p_2) = \Phi \left(\frac{c - np_2}{\sqrt{np_2(1 - p_2)}} \right) \leq \beta \quad (9)$$

where, p_1 and p_2 denote the probabilities of failure during the time $[0, t_0]$, respectively for a good lot and a poor lot, and α and β represent the producer's and consumer's risk respectively.

The value of p_1 and p_2 are obtained by considering $\frac{t_q}{t_q^0} > 1$ and $\frac{t_q}{t_q^0} = 1$ in Eq. (4)

The objective is to find the minimum pair (n, c) that satisfies both inequalities in (9).

4. Definitions and Decision Responsibilities for Reliability Sampling Parameters

Symbol	Meaning	Who Decides?	How?	Example
θ	Shape parameter — determines the behavior of the hazard rate (increasing, decreasing, constant).	Producer	Based on past life data, historical testing, or assumed from prior studies.	Estimated from historical failure times.
q	Quantile level of lifetime (e.g., 0.25 for the 25th percentile), used as a quality threshold.	Consumer	Required reliability or early failure tolerance.	Consumer requires no more than 25% failure before 50 hours $\Rightarrow q = 0.25$
α	Producer's risk — probability of rejecting a good lot (Type I error).	Producer	Typically fixed at 0.05. Reflects producer's confidence in product quality.	A good-quality batch may be wrongly rejected 5% of the time.
β	Consumer's risk — probability of accepting a bad lot (Type II error).	Consumer	Consumer tolerates a specific risk level (e.g., 10%) of accepting subpar products.	A poor-quality batch may be accepted 10% of the time.
t_q^0	Required quantile life — the time by which no more than $q \times 100\%$ of units should fail.	Consumer	Set as a performance standard to ensure most units last beyond this time.	$t_q^0 = 50$ hours; 75% should survive beyond 50 hours.
t_q	Actual quantile life of the product — estimated from test or historical data.	Producer	Calculated using statistical models (e.g., Inverted Weibull) and observed lifetime data.	Estimated from product test results: $t_q = 100$ hours.
t	Truncation time — maximum time for which items are tested.	Jointly by producer & consumer	Based on practical constraints like time, cost, and the ability to observe early failures.	Test each item for 40 hours.
δ_0	Test severity ratio — ratio of test time to required quantile life: $\delta_0 = \frac{t}{t_q^0}$	Computed (not directly decided)	Derived from t and t_q^0 . Indicates how harsh or short the test is.	$t = 40, t_q^0 = 50 \Rightarrow \delta_0 = 0.8$ You're testing each item for only 80% of the required 25th percentile life.
$\frac{t_q}{t_q^0}$	Quality ratio — compares actual product life to required life; higher means better quality.	Computed	From test results and consumer requirements.	$t_q = 100, t_q^0 = 50 \Rightarrow$ quality ratio = 2.
n	Sample size — number of items put on test.	Jointly by producer & consumer	Based on statistical design to meet risk requirements (α, β), cost, and confidence.	$n = 10$; items tested.
c	Acceptance number — maximum allowable number of failures during test for the lot to be accepted.	Jointly by producer & consumer	Determined using binomial or acceptance sampling tables based on α, β	$c = 3$; Accept if 3 or fewer fail.
$L(p_1)$	Probability of accepting a lot when the lot meets required quality level. (Good lot) (should be close to $= 1 - \alpha$)	Computed	$L(p_1) \approx 1 - \alpha$. Calculated using binomial/inverse Weibull reliability function at good quality level.	If $\alpha = 0.05$, then $L(p_1) \approx 0.95$
$L(p_2)$	Probability of accepting a lot when the lot fails to meet quality requirements. (Bad lot) (should be close to $\approx \beta$)	Computed	$L(p_2) \approx \beta$. Ensures bad lots are rarely accepted. Calculated based on poor quality level (e.g., $t_q < t_q^0$)	If $\beta = 0.10$, then $L(p_2) \approx 0.1$

5. Key Observations from [Tables 1(a) – Tables 1(b), Table 2(a) – Table 2(d)]

- Increasing $\frac{t_q}{t_q^0}$ (i.e., higher quality),
 - Results in smaller sample sizes n
 - Often reduces the acceptance number c

- Keeps $L(p_1) \approx 1$ (i.e., better chances of accepting good lots)
- 2. Lower Consumer Risk (β)
 - Increases sample size substantially
 - For example, in Table 1(a), $\beta=0.25$ with $\frac{t_q}{t_q^0} = 1.2, n = 166, c = 6$ but for $\beta = 0.01$, it increases to $n = 591, c = 17$
- 3. Effect of Shape Parameter θ
 - Higher θ (more "light-tailed" failure distributions) leads to more efficient plans
 - For instance, for $\beta = 0.05, \delta_0 = 1, \frac{t_q}{t_q^0} = 2$:
 - Table 1(a): $n = 10$
 - Table 1(d): $n = 19$
 - Slight increase, but acceptance probabilities $L(p_1) \approx 1, L(p_2) \approx 0.04$
- 4. Acceptance Probabilities
 - $L(p_1)$ is consistently high (≥ 0.95), meaning good lots are likely to be accepted.
 - $L(p_2)$ approximately equals the specified β , confirming that the design meets the consumer's protection requirements.

6. Practical Use

(How a Producer or Consumer Can Use the Acceptance Sampling Plan Tables)

Situation

A producer manufactures components that are known, based on past data, to follow an Inverted Weibull Distribution with a shape parameter $\theta = 2$. The consumer requires that the 25th percentile life of the product be at least 50 hours, i.e., Out of 100 products, at least 75 should last more than 50 hours. To verify this, the producer and consumer agree to conduct a truncated life test and use a binomial acceptance sampling plan.

Known Inputs

Shape parameter: $\theta = 2$ (decided by producer based on historical data)

Required 25th percentile life: $t_q^0 = 50$ hours (decided by consumer which is reliability requirement)

Actual observed 25th percentile life: $t_q = 100$ hours (decided by producer based on actual data)

Truncation time (test duration): $t = 40$ hours (decided by both)

Producer's risk: $\alpha = 0.05$

Consumer's risk: $\beta = 0.10$

Number of observed failures during test: $d = 3$

Step 1: Compute Plan Parameters

Quality ratio: $\frac{t_q}{t_q^0} = \frac{100}{50} = 2$

Truncation ratio: $\delta_0 = \frac{t}{t_q^0} = \frac{40}{50} = 0.8$

Step 2: Refer to Table 1(b)

From the table for shape parameter $\theta = 2$, at: $\delta_0 = 0.8, \frac{t_q}{t_q^0} = 2, \beta = 0.10, \alpha = 0.05$

We obtain the sampling plan: $(n, c) = (34, 1)$

This means:

Test a sample of 34 units

Accept the lot if 1 or fewer units fail during the 40-hour test

Step 3: Decision

In this case:

Number of failures observed = 3

Acceptance number $c = 1$

Since $d > c$, the decision is to Reject the lot

Interpretation for a Producer

The producer uses the table to select the correct sample size and acceptance number based on the product's expected reliability. This allows them to make quick, cost-effective decisions without needing to wait for full product life cycles.

Interpretation for a Consumer

The consumer is assured that, with a 10% consumer's risk ($\beta = 0.10$), lots that do not meet the required 25th percentile life is unlikely to be accepted, i.e., Consumer's risk ($\beta = 0.10$) means there is only a 10% chance that a bad batch (where less than 25% of the items last 50 hours) will be accepted by the testing process by accident. So, 90% of the time, bad batches will be correctly rejected.

This example illustrates the practical use of the proposed acceptance sampling tables by both producers and consumers. It highlights how quantile-based truncated life testing under the Inverted Weibull model can provide an efficient and statistically reliable decision-making process in real-world quality control environments.

7. Real Life Example

The below data is of failure times of the air conditioning system of an airplane taken from (Linhart & Zucchini, 1986).

Data: 23, 261, 87, 7, 120, 14, 62, 47, 225, 71, 246, 21, 42, 20, 5, 12, 120, 11, 3, 14, 71, 11, 14, 11, 16, 90, 1, 16, 52, 95.

To model the reliability behaviour of the product, the original failure time data was first converted to inverse failure times, as required by the Inverted Weibull framework. The transformed data is as follows:

Inverse Failure Times:

0.0435, **0.0038**, **0.0115**, 0.1429, **0.0083**, 0.0714, **0.0161**, **0.0213**, **0.0044**, **0.0141**, **0.0041**, 0.0476, 0.0238, 0.0500, 0.2000, 0.0833, **0.0083**, 0.0909, 0.3333, 0.0714, **0.0141**, 0.0909, 0.0714, 0.0909, 0.0625, **0.0111**, 1.0000, 0.0625, **0.0192**, **0.0105 (ignored)**

The maximum likelihood estimation method was used to estimate the parameters of the Inverted Weibull distribution. Estimated values are: Shape parameter ($\hat{\theta}$) = 0.852, Scale parameter ($\hat{\sigma}$) = 0.0331

To assess the goodness-of-fit of the Inverted Weibull model to the given data, the Kolmogorov–Smirnov (K–S) test was applied. The resulting p-value = 0.4814, which is greater than the standard significance level of 0.05. Therefore, we conclude that the Inverted Weibull distribution fits the given data well.

To implement the life test sampling plan, the inverse failure times were arranged in ascending order:

Ordered Data: 0.0038, 0.0041, 0.0044, 0.0083, 0.0083, **0.0105 (ignored)**, 0.0111, 0.0115, 0.0141, 0.0141, 0.0161, 0.0192, 0.0213, 0.0238, 0.0435, 0.0476, 0.0500, 0.0625, 0.0625, 0.0714, 0.0714, 0.0714, 0.0833, 0.0909, 0.0909, 0.0909, 0.1429, 0.2000, 0.3333, 1.0000

The 50th quantile (median) of the ordered data is: $t_q = t_{0.5} = 0.04555$

Suppose we take the specified threshold value for comparison as $t_q^0 = 0.022775$, then:

$$\frac{t_q}{t_q^0} = \frac{0.04555}{0.022775} = 2$$

Letting the truncation time be $t = 0.022775$,

We compute the termination ratio: $\delta_0 = \frac{t}{t_q^0} = \frac{0.022775}{0.022775} = 1$.

From the data, the number of failures within the test duration is: $d = \sum_{j=1}^{29} I_j = 12$

Using the consumer's risk $\beta = 0.25$ and the parameter set $(\hat{\theta}, \frac{t_q}{t_q^0}, \delta_0) = (0.852, 2, 1)$ we refer to Table 3 (for $\theta = 0.85$), which gives the corresponding sampling plan values: $(n, c) = (29, 12)$

Since the observed number of failures $d = 12$ (first 29 observation are inspected and last observation i.e., 95 is ignored) is equal to the acceptance number $c = 12$, the lot would be accepted under the proposed life test sampling plan.

8. Conclusion

This study proposes a binomial-based acceptance sampling plan for truncated life tests whose lifetimes follow the Inverted Weibull Distribution (IWD). The study focusing on quantile life i.e., 25th and 50th percentiles, a practical alternative to mean-based plans. The methodology enables the determination of minimum sample sizes and acceptance numbers that meet specified risk levels within a fixed test duration. Comprehensive plan tables were generated across various shape parameters for different industrial conditions. The practical relevance of the approach was demonstrated using real-world data. Overall, the research contributes a simple, efficient, and statistically sound framework for life test sampling in reliability engineering, especially in settings where early-life performance and risk-based decision-making are crucial.

Appendix

R-Code

```
alpha <- 0.05
beta_vec <- c(0.25, 0.1, 0.05, 0.01)
c_vec <- 1:200
delta_vec <- c(0.6, 0.8, 1.0)
q <- 0.5
theta <- 3.0
b <- (-log(q))^(1 / theta)
lambda_vec <- c(1.2, 1.4, 1.6, 1.8, 2.0)

results <- data.frame() # Store final results

for (w in seq_along(beta_vec)) {
  beta_val <- beta_vec[w]

  for (j in seq_along(delta_vec)) {
    delta_val <- delta_vec[j]

    for (l in seq_along(lambda_vec)) {
      lambda_val <- lambda_vec[l]

      x_n <- c()
      x_c <- c()
      x_p1 <- c()
      x_p2 <- c()
```

```

for (c in c_vec) {
  found <- FALSE

  for (n in c:10000) {
    # Failure probabilities
    p1 <- exp(-((lambda_val / (delta_val * b))^theta))
    p2 <- exp(-((1 / (delta_val * b))^theta))

    # Normal approximation with continuity correction
    mu1 <- n * p1
    sigma1 <- sqrt(n * p1 * (1 - p1))
    prob1 <- pnorm(c + 0.5, mean = mu1, sd = sigma1)

    mu2 <- n * p2
    sigma2 <- sqrt(n * p2 * (1 - p2))
    prob2 <- pnorm(c + 0.5, mean = mu2, sd = sigma2)

    if ((prob1 >= 1 - alpha) && (prob2 <= beta_val)) {
      x_n <- c(x_n, n)
      x_c <- c(x_c, c)
      x_p1 <- c(x_p1, prob1)
      x_p2 <- c(x_p2, prob2)
      found <- TRUE
      break # Stop once you find minimum n for this c
    }
  }
}

# Identify the best (n, c) with smallest n
if (length(x_n) > 0) {
  idx <- which.min(x_n)
  result <- data.frame(
    beta = beta_val,
    lambda = lambda_val,
    delta = delta_val,
    n = x_n[idx],
    c = x_c[idx],
    prob1 = x_p1[idx],
    prob2 = x_p2[idx]
  )
  results <- rbind(results, result)

  cat(sprintf("%0.2f, %0.1f, %0.2f, %d, %d, %0.4f, %0.4f\n",
    beta_val, lambda_val, delta_val,
    x_n[idx], x_c[idx], x_p1[idx], x_p2[idx]))
} else {
  cat(sprintf("%0.2f, %0.1f, %0.2f=> No valid (n,c) found\n",
    beta_val, lambda_val, delta_val))
}
}
}
}
}

```

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Table 1(a): Lot Acceptance Sampling Plan under Inverted Weibull Distribution $\theta = 1.5$ (Shape Parameter), $q = 0.25$ (25th Quantile), $\alpha = 0.05$ (Producer's Risk)

β	$\frac{t_q}{t_q^0}$	$\delta_0 = 0.6$				$\delta_0 = 0.8$				$\delta_0 = 1.0$			
		n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$
0.25	1.2	166	6	0.9631	0.2498	112	13	0.9518	0.239	111	24	0.9545	0.2381
	1.4	51	1	0.9705	0.2446	34	3	0.9681	0.2473	33	6	0.9671	0.2409
	1.6	51	1	1	0.2446	18	1	0.9734	0.2315	15	2	0.9578	0.228
	1.8	51	1	1	0.2446	18	1	0.9995	0.2315	10	1	0.9757	0.2326
	2	51	1	1	0.2446	18	1	1	0.2315	10	1	0.9984	0.2326
0.1	1.2	281	9	0.9537	0.099	193	21	0.9563	0.098	176	36	0.9504	0.0958
	1.4	107	2	0.9768	0.099	63	5	0.9707	0.0997	55	9	0.9623	0.0928
	1.6	79	1	0.9987	0.0997	37	2	0.9814	0.0925	31	4	0.9761	0.0888
	1.8	79	1	1	0.0997	27	1	0.9939	0.0951	20	2	0.9854	0.0984
	2	79	1	1	0.0997	27	1	1	0.0951	15	1	0.9871	0.0899
0.05	1.2	387	12	0.9609	0.0499	247	26	0.9548	0.0498	225	45	0.9509	0.049
	1.4	159	3	0.987	0.0498	82	6	0.9632	0.0473	70	11	0.9617	0.0488
	1.6	102	1	0.9946	0.0489	44	2	0.9609	0.0497	35	4	0.9545	0.0486
	1.8	102	1	1	0.0489	34	1	0.9829	0.0485	24	2	0.9668	0.0495
	2	102	1	1	0.0489	34	1	0.9998	0.0485	19	1	0.9678	0.0425
0.01	1.2	591	17	0.9561	0.0098	370	37	0.9503	0.0096	336	65	0.9513	0.0099
	1.4	248	4	0.9801	0.0098	131	9	0.9691	0.0098	103	15	0.9537	0.0098
	1.6	156	1	0.9678	0.0097	73	3	0.9576	0.0097	57	6	0.9551	0.0089
	1.8	156	1	1	0.0097	62	2	0.9946	0.01	40	3	0.9639	0.0088
	2	156	1	1	0.0097	51	1	0.9974	0.0099	34	2	0.9877	0.0087

Table 1(b): Lot Acceptance Sampling Plan under Inverted Weibull Distribution $\theta = 2$ (Shape Parameter), $q = 0.25$ (25th Quantile), $\alpha = 0.05$ (Producer's Risk)

β	$\frac{t_q}{t_0^q}$	$\delta_0 = 0.6$				$\delta_0 = 0.8$				$\delta_0 = 1.0$			
		n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$
0.25	1.2	179	2	0.9845	0.2493	63	5	0.952	0.248	59	12	0.9558	0.2494
	1.4	121	1	1	0.2495	22	1	0.9832	0.247	20	3	0.9751	0.2193
	1.6	121	1	1	0.2495	22	1	1	0.247	10	1	0.9891	0.2326
	1.8	121	1	1	0.2495	22	1	1	0.247	10	1	1	0.2326
	2	121	1	1	0.2495	22	1	1	0.247	10	1	1	0.2326
0.1	1.2	321	3	0.9778	0.0991	123	9	0.9627	0.0965	101	19	0.9534	0.0932
	1.4	191	1	1	0.0995	46	2	0.9888	0.0997	31	4	0.9619	0.0888
	1.6	191	1	1	0.0995	34	1	0.9999	0.0984	15	1	0.9506	0.0899
	1.8	191	1	1	0.0995	34	1	1	0.0984	15	1	0.9995	0.0899
	2	191	1	1	0.0995	34	1	1	0.0984	15	1	1	0.0899
0.05	1.2	448	4	0.9814	0.0499	158	11	0.9598	0.0494	126	23	0.9515	0.0499
	1.4	246	1	0.9999	0.0496	57	2	0.9697	0.0468	41	5	0.9604	0.0433
	1.6	246	1	1	0.0496	44	1	0.9993	0.0468	24	2	0.9865	0.0495
	1.8	246	1	1	0.0496	44	1	1	0.0468	19	1	0.9975	0.0425
	2	246	1	1	0.0496	44	1	1	0.0468	19	1	1	0.0425
0.01	1.2	666	5	0.9641	0.01	246	16	0.9596	0.0096	195	34	0.953	0.0092
	1.4	378	1	0.9982	0.0099	93	3	0.9707	0.0099	62	7	0.9591	0.0095
	1.6	378	1	1	0.0099	66	1	0.9929	0.0096	40	3	0.9869	0.0088
	1.8	378	1	1	0.0099	66	1	1	0.0096	27	1	0.9857	0.0098
	2	378	1	1	0.0099	66	1	1	0.0096	27	1	1	0.0098

Table 1(c): Lot Acceptance Sampling Plan under Inverted Weibull Distribution $\theta = 2.5$ (Shape Parameter), $q = 0.25$ (25th Quantile), $\alpha = 0.05$ (Producer's Risk)

β	$\frac{t_q}{t_0^q}$	$\delta_0 = 0.6$				$\delta_0 = 0.8$				$\delta_0 = 1.0$			
		n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$
0.25	1.2	373	1	0.9998	0.249	56	3	0.9809	0.2448	38	7	0.9517	0.2268
	1.4	373	1	1	0.249	29	1	1	0.2415	10	1	0.9616	0.2326
	1.6	373	1	1	0.249	29	1	1	0.2415	10	1	1	0.2326
	1.8	373	1	1	0.249	29	1	1	0.2415	10	1	1	0.2326
	2	373	1	1	0.249	29	1	1	0.2415	10	1	1	0.2326
0.1	1.2	589	1	0.9958	0.0997	90	4	0.9655	0.098	64	11	0.9562	0.097
	1.4	589	1	1	0.0997	45	1	0.9995	0.0955	20	2	0.9734	0.0984
	1.6	589	1	1	0.0997	45	1	1	0.0955	15	1	0.9994	0.0899
	1.8	589	1	1	0.0997	45	1	1	0.0955	15	1	1	0.0899
	2	589	1	1	0.0997	45	1	1	0.0955	15	1	1	0.0899
0.05	1.2	759	1	0.9861	0.0499	120	5	0.9632	0.0491	85	14	0.9557	0.0454
	1.4	759	1	1	0.0499	57	1	0.9978	0.0487	30	3	0.9836	0.0458
	1.6	759	1	1	0.0499	57	1	1	0.0487	19	1	0.9975	0.0425
	1.8	759	1	1	0.0499	57	1	1	0.0487	19	1	1	0.0425
	2	759	1	1	0.0499	57	1	1	0.0487	19	1	1	0.0425
0.01	1.2	1404	2	0.9957	0.01	187	7	0.9552	0.0097	128	20	0.9569	0.0095
	1.4	1168	1	1	0.01	87	1	0.9825	0.0095	46	4	0.9768	0.0086
	1.6	1168	1	1	0.01	87	1	1	0.0095	27	1	0.9856	0.0098
	1.8	1168	1	1	0.01	87	1	1	0.0095	27	1	1	0.0098
	2	1168	1	1	0.01	87	1	1	0.0095	27	1	1	0.0098

Table 1(d): Lot Acceptance Sampling Plan under Inverted Weibull Distribution $\theta = 3$ (Shape Parameter), $q = 0.25$ (25th Quantile), $\alpha = 0.05$ (Producer's Risk)

		$\delta_0 = 0.6$				$\delta_0 = 0.8$				$\delta_0 = 1.0$			
β	$\frac{t_q}{t_q^0}$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$
0.25	1.2	1583	1	1	0.25	39	1	0.9712	0.2399	29	5	0.9674	0.2265
	1.4	1583	1	1	0.25	39	1	1	0.2399	10	1	0.9969	0.2326
	1.6	1583	1	1	0.25	39	1	1	0.2399	10	1	1	0.2326
	1.8	1583	1	1	0.25	39	1	1	0.2399	10	1	1	0.2326
	2	1583	1	1	0.25	39	1	1	0.2399	10	1	1	0.2326
0.1	1.2	2507	1	1	0.0999	81	2	0.9785	0.0981	45	7	0.9609	0.0984
	1.4	2507	1	1	0.0999	60	1	1	0.0977	15	1	0.9793	0.0899
	1.6	2507	1	1	0.0999	60	1	1	0.0977	15	1	1	0.0899
	1.8	2507	1	1	0.0999	60	1	1	0.0977	15	1	1	0.0899
	2	2507	1	1	0.0999	60	1	1	0.0977	15	1	1	0.0899
0.05	1.2	3233	1	1	0.05	99	2	0.9511	0.0492	61	9	0.9602	0.0445
	1.4	3233	1	1	0.05	77	1	1	0.0484	19	1	0.9529	0.0425
	1.6	3233	1	1	0.05	77	1	1	0.0484	19	1	1	0.0425
	1.8	3233	1	1	0.05	77	1	1	0.0484	19	1	1	0.0425
	2	3233	1	1	0.05	77	1	1	0.0484	19	1	1	0.0425
0.01	1.2	4980	1	1	0.01	187	4	0.9824	0.0097	88	12	0.9515	0.0097
	1.4	4980	1	1	0.01	117	1	1	0.0098	34	2	0.9785	0.0087
	1.6	4980	1	1	0.01	117	1	1	0.0098	27	1	1	0.0098
	1.8	4980	1	1	0.01	117	1	1	0.0098	27	1	1	0.0098
	2	4980	1	1	0.01	117	1	1	0.0098	27	1	1	0.0098

Table 2(a): Lot Acceptance Sampling Plan under Inverted Weibull Distribution $\theta = 1.5$ (Shape Parameter), $q = 0.5$ (50th Quantile), $\alpha = 0.05$ (Producer's Risk)

		$\delta_0 = 0.6$				$\delta_0 = 0.8$				$\delta_0 = 1.0$			
β	$\frac{t_q}{t_q^0}$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$
0.25	1.2	104	20	0.9507	0.2475	116	40	0.9517	0.2497	139	65	0.9519	0.2487
	1.4	32	5	0.9621	0.2357	33	10	0.9536	0.2337	42	18	0.957	0.2202
	1.6	17	2	0.9698	0.2206	19	5	0.9688	0.2092	18	7	0.9538	0.2398
	1.8	11	1	0.9868	0.2406	10	2	0.9501	0.1992	12	4	0.9519	0.1932
	2	11	1	0.9996	0.2406	10	2	0.9915	0.1992	7	2	0.9501	0.2248
0.1	1.2	176	32	0.9529	0.0997	190	63	0.9524	0.0988	227	103	0.9511	0.0922
	1.4	56	8	0.9648	0.0946	53	15	0.9518	0.0956	64	26	0.952	0.0846
	1.6	29	3	0.9636	0.0892	29	7	0.966	0.0898	33	12	0.9619	0.0819
	1.8	23	2	0.9917	0.0907	16	3	0.9514	0.0925	19	6	0.9579	0.0843
	2	17	1	0.9941	0.0884	13	2	0.9695	0.0821	14	4	0.974	0.0907
0.05	1.2	226	40	0.9516	0.0494	245	80	0.9552	0.05	281	126	0.95	0.0474
	1.4	73	10	0.9657	0.0483	69	19	0.9547	0.0485	80	32	0.9565	0.0468
	1.6	40	4	0.969	0.0441	35	8	0.9587	0.0478	40	14	0.9566	0.041
	1.8	27	2	0.9814	0.0497	22	4	0.9572	0.0453	23	7	0.9557	0.0476
	2	21	1	0.9845	0.0459	19	3	0.9831	0.0396	18	5	0.9778	0.0495
0.01	1.2	340	58	0.9513	0.0096	358	114	0.9539	0.0099	406	179	0.9502	0.0098
	1.4	110	14	0.9627	0.0096	103	27	0.9528	0.0093	114	44	0.9533	0.0096
	1.6	64	6	0.9747	0.009	52	11	0.9522	0.0093	57	19	0.9542	0.0086
	1.8	45	3	0.9812	0.009	35	6	0.9633	0.0091	35	10	0.9559	0.009

	2	38	2	0.9955	0.0094	28	4	0.9808	0.0085	25	6	0.9567	0.0082
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Table 2(b): Lot Acceptance Sampling Plan under Inverted Weibull Distribution $\theta = 2$ (Shape Parameter), $q = 0.5$ (50th Quantile), $\alpha = 0.05$ (Producer's Risk)

β	$\frac{t_q}{t_q^0}$	$\delta_0 = 0.6$				$\delta_0 = 0.8$				$\delta_0 = 1.0$			
		n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$
0.25	1.2	65	7	0.9609	0.2435	66	19	0.9554	0.2296	77	35	0.9537	0.2471
	1.4	18	1	0.9564	0.2263	18	4	0.9557	0.2136	23	9	0.9566	0.2021
	1.6	18	1	0.9999	0.2263	7	1	0.9514	0.2436	12	4	0.971	0.1932
	1.8	18	1	1	0.2263	7	1	0.9979	0.2436	7	2	0.9847	0.2248
	2	18	1	1	0.2263	7	1	1	0.2436	5	1	0.9859	0.1855
0.1	1.2	112	11	0.9605	0.0979	103	28	0.9511	0.0923	126	55	0.9529	0.0907
	1.4	36	2	0.9687	0.0971	29	6	0.9584	0.0964	35	13	0.9593	0.0881
	1.6	27	1	0.9985	0.0919	15	2	0.9522	0.0797	17	5	0.9546	0.0728
	1.8	27	1	1	0.0919	11	1	0.9809	0.0782	9	2	0.9532	0.0912
	2	27	1	1	0.0919	11	1	0.9998	0.0782	7	1	0.9514	0.0653
0.05	1.2	140	13	0.9514	0.0489	128	34	0.9502	0.0494	156	67	0.9516	0.0463
	1.4	53	3	0.9818	0.0499	40	8	0.9647	0.046	42	15	0.9517	0.0448
	1.6	34	1	0.9944	0.0465	21	3	0.9757	0.048	21	6	0.9563	0.0404
	1.8	34	1	1	0.0465	13	1	0.9647	0.0445	13	3	0.9722	0.048
	2	34	1	1	0.0465	13	1	0.9994	0.0445	11	2	0.988	0.0352
0.01	1.2	217	19	0.9521	0.0098	195	50	0.9526	0.0094	224	94	0.9509	0.0097
	1.4	82	4	0.9732	0.0098	59	11	0.9624	0.0099	64	22	0.9582	0.0088
	1.6	51	1	0.9692	0.0092	32	4	0.9661	0.009	30	8	0.9516	0.0088
	1.8	51	1	1	0.0092	23	2	0.9867	0.0099	20	4	0.9584	0.007
	2	51	1	1	0.0092	19	1	0.9941	0.0084	14	2	0.9636	0.0081

Table 2(c): Lot Acceptance Sampling Plan under Inverted Weibull Distribution $\theta = 2.5$ (Shape Parameter), $q = 0.5$ (50th Quantile), $\alpha = 0.05$ (Producer's Risk)

β	$\frac{t_q}{t_q^0}$	$\delta_0 = 0.6$				$\delta_0 = 0.8$				$\delta_0 = 1.0$			
		n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$
0.25	1.2	46	2	0.9535	0.2389	39	9	0.9535	0.229	48	21	0.9512	0.2352
	1.4	31	1	1	0.2411	12	2	0.9844	0.2487	14	5	0.964	0.2113
	1.6	31	1	1	0.2411	8	1	0.9997	0.2473	7	2	0.9846	0.2248
	1.8	31	1	1	0.2411	8	1	1	0.2473	5	1	0.9953	0.1855
	2	31	1	1	0.2411	8	1	1	0.2473	5	1	1	0.1855
0.1	1.2	96	4	0.9714	0.0984	65	14	0.9557	0.0935	79	33	0.9531	0.0885
	1.4	48	1	0.9998	0.096	21	3	0.9797	0.0942	21	7	0.9636	0.0952
	1.6	48	1	1	0.096	12	1	0.9955	0.0951	9	2	0.953	0.0912
	1.8	48	1	1	0.096	12	1	1	0.0951	7	1	0.9784	0.0653
	2	48	1	1	0.096	12	1	1	0.0951	7	1	0.9999	0.0653
0.05	1.2	128	5	0.9699	0.0494	82	17	0.9522	0.0471	100	41	0.9548	0.0446
	1.4	61	1	0.9986	0.0486	25	3	0.9529	0.0421	28	9	0.9668	0.0445
	1.6	61	1	1	0.0486	15	1	0.9871	0.0469	13	3	0.9721	0.048
	1.8	61	1	1	0.0486	15	1	1	0.0469	8	1	0.9649	0.0385
	2	61	1	1	0.0486	15	1	1	0.0469	8	1	0.9997	0.0385
0.01	1.2	199	7	0.9647	0.01	126	25	0.957	0.0095	141	56	0.9506	0.0092
	1.4	93	1	0.9875	0.0096	42	5	0.9727	0.009	40	12	0.9617	0.0089

1.6	93	1	1	0.0096	27	2	0.9967	0.0098	20	4	0.9581	0.007
1.8	93	1	1	0.0096	22	1	1	0.0092	14	2	0.9875	0.0081
2	93	1	1	0.0096	22	1	1	0.0092	11	1	0.9972	0.0079

Table 2(d): Lot Acceptance Sampling Plan under Inverted Weibull Distribution $\theta = 3$ (Shape Parameter), $q = 0.5$ (50th Quantile), $\alpha = 0.05$ (Producer's Risk)

β	$\frac{t_q}{t_0^q}$	$\delta_0 = 0.6$				$\delta_0 = 0.8$				$\delta_0 = 1.0$			
		n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$
0.25	1.2	64	1	0.9939	0.2454	28	5	0.9636	0.2274	33	14	0.9574	0.2431
	1.4	64	1	1	0.2454	10	1	0.995	0.2171	10	3	0.9626	0.1714
	1.6	64	1	1	0.2454	10	1	1	0.2171	5	1	0.9893	0.1855
	1.8	64	1	1	0.2454	10	1	1	0.2171	5	1	1	0.1855
	2	64	1	1	0.2454	10	1	1	0.2171	5	1	1	0.1855
0.1	1.2	100	1	0.9623	0.0985	44	7	0.952	0.0916	53	21	0.9501	0.0848
	1.4	100	1	1	0.0985	14	1	0.9777	0.0982	14	4	0.9647	0.0907
	1.6	100	1	1	0.0985	14	1	1	0.0982	7	1	0.9605	0.0653
	1.8	100	1	1	0.0985	14	1	1	0.0982	7	1	1	0.0653
	2	100	1	1	0.0985	14	1	1	0.0982	7	1	1	0.0653
0.05	1.2	165	2	0.9897	0.0498	59	9	0.9537	0.044	67	26	0.9525	0.0436
	1.4	128	1	1	0.0497	24	2	0.9944	0.0423	18	5	0.9686	0.0495
	1.6	128	1	1	0.0497	18	1	1	0.045	11	2	0.9915	0.0352
	1.8	128	1	1	0.0497	18	1	1	0.045	8	1	0.9999	0.0385
	2	128	1	1	0.0497	18	1	1	0.045	8	1	1	0.0385
0.01	1.2	275	3	0.9905	0.0099	90	13	0.9576	0.0095	96	36	0.9527	0.0095
	1.4	196	1	1	0.0099	32	2	0.9757	0.01	28	7	0.9609	0.007
	1.6	196	1	1	0.0099	26	1	1	0.0097	14	2	0.9723	0.0081
	1.8	196	1	1	0.0099	26	1	1	0.0097	11	1	0.9987	0.0079
	2	196	1	1	0.0099	26	1	1	0.0097	11	1	1	0.0079

Table 3: Lot Acceptance Sampling Plan under Inverted Weibull Distribution $\theta = 0.852$ (Shape Parameter), $q = 0.5$ (50th Quantile), $\alpha = 0.05$ (Producer's Risk)

β	$\frac{t_q}{t_0^q}$	$\delta_0 = 0.6$				$\delta_0 = 0.8$				$\delta_0 = 1.0$			
		n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$	n	c	$L(p_1)$	$L(p_2)$
0.25	1.2	361	117	0.9508	0.2463	403	167	0.9514	0.2478	-	-	-	-
	1.4	105	32	0.9521	0.2374	116	46	0.9541	0.2461	129	60	0.9521	0.2406
	1.6	52	15	0.9575	0.2493	58	22	0.9568	0.2469	65	29	0.9514	0.2284
	1.8	34	9	0.9538	0.2187	36	13	0.9572	0.2433	42	18	0.9549	0.2202
	2	24	6	0.9606	0.2293	26	9	0.963	0.245	29	12	0.9578	0.2288
0.1	1.2	582	184	0.9501	0.0965	-	-	-	-	-	-	-	-
	1.4	168	49	0.9511	0.095	183	70	0.9523	0.0987	206	93	0.9517	0.0928
	1.6	85	23	0.956	0.0994	92	33	0.951	0.093	100	43	0.9519	0.0968
	1.8	56	14	0.9602	0.0935	59	20	0.9567	0.0938	66	27	0.9563	0.0879
	2	39	9	0.9605	0.0963	41	13	0.954	0.0912	46	18	0.9591	0.0923
0.05	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.4	213	61	0.9517	0.0487	231	87	0.952	0.0499	258	115	0.9512	0.0464
	1.6	107	28	0.9508	0.0482	119	42	0.9566	0.0486	128	54	0.9519	0.0465
	1.8	71	17	0.955	0.0439	73	24	0.9528	0.0475	80	32	0.9537	0.0468
	2	50	11	0.9569	0.0467	52	16	0.9544	0.0469	58	22	0.9568	0.0439

0.01	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.4	316	88	0.9519	0.0096	342	126	0.953	0.0098	370	162	0.9505	0.0097
	1.6	159	40	0.9505	0.0098	173	59	0.9536	0.0094	185	76	0.9507	0.0093
	1.8	101	23	0.9508	0.0099	108	34	0.9502	0.0089	119	46	0.9543	0.0086
	2	77	16	0.9588	0.0088	78	23	0.958	0.0097	85	31	0.9574	0.0085

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