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Confidence Intervals for the Difference and Ratio of Two Variances of Delta–Inverse Gaussian Distributions

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Abstract

Accurate statistical inference for zero-inflated and highly skewed data requires confidence interval procedures with a strong finite-sample performance. The delta–inverse Gaussian distribution provides a flexible framework for modeling such data by combining a point mass at zero with an inverse Gaussian distribution for positive observations, making it suitable for application in various fields such as traffic mortality, insurance, and environmental studies. This paper develops and compares several confidence interval estimation methods for the difference and the ratio of two variances from independent delta–IG distributions. The proposed approaches include adjusted generalized confidence intervals, fiducial confidence intervals, Bayesian credible intervals, the method of variance estimates recovery, and normal approximation methods used as benchmarks. The finite-sample performance of these methods is evaluated through Monte Carlo simulations under various parameter configurations and both balanced and unbalanced sample sizes, with an emphasis on coverage probability and interval width. The simulation results show that AGCI and MOVER generally achieve coverage probabilities close to the nominal level while producing relatively narrow intervals. The MOVER performs particularly well when zero-inflation probabilities are equal, whereas AGCI is more effective when they differ. Illustrative real-data examples are provided to demonstrate practical implementations.

Keywords: adjusted generalized confidence interval; Bayesian credible interval; fiducial confidence interval; method of variance estimates recovery; normal approximation

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1. Introduction

Estimating population parameters is a fundamental task in statistical inference, where point estimation and interval estimation play complementary roles. While point estimates provide single-value summaries, confidence intervals (CIs) quantify sampling uncertainty and are therefore essential for reliable statistical conclusions. In many practical situations, the performance of classical CI procedures based on normal approximations or large-sample theory can be unsatisfactory, particularly when the underlying data are highly skewed, heavy-tailed, or exhibit a substantial proportion of exact zeros. Developing CI methods with strong finite-sample properties for such data structures remains an important challenge in modern statistical inference.

The zero-inflated and semi-continuous data arise naturally in a wide range of applied fields, including insurance claim modeling, environmental and hydrological studies, reliability and survival analysis, epidemiology, and transportation-related research. In these

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settings, observations often consist of a mixture of a point mass at zero and a continuous distribution for positive values. Research on zero-inflated models for several distributions has established confidence intervals and addressed the needs of zero-inflated data, such as the delta–lognormal [1,2], delta–gamma [3], and delta–inverse Gaussian [4]. These models explicitly account for excess zeros while retaining flexibility for modeling right-skewed positive outcomes. Folks and Chhikara [5] noted that, among skewed continuous distributions, the inverse Gaussian (IG) distribution has received considerable attention due to its analytical tractability and flexibility in capturing varying degrees of skewness. Originally linked to Brownian motion first-passage times [6], the IG is part of the exponential family and defined by a mean and shape parameter. Its versatility in modeling skewness is notable: higher values yield distributions that are similar to the normal distribution, while lower values yield distributions with heavy tails. The IG is relevant to survival analysis, reliability testing, atmospheric phenomena such as precipitation, and actuarial risk modeling [7]. Chatzidiamantis et al. [8] highlighted its effectiveness for modeling wind speed, while Bardsley [9] found it less complex than the three-parameter Weibull distribution.

The delta–IG distribution is an extension of the IG distribution designed for zero-inflated data. It addresses zero inflation while maintaining the IG distribution's capacity to model heavy right tails, thus making it suitable for skewed, zero-inflated outcomes such as accident counts or waiting times [7]. The delta–IG distribution introduces a parameter that accounts for the probability mass at zero, preserving the IG distribution's effectiveness for modeling skewed positive data and permitting the explicit modeling of zero-inflated outcomes. The delta–IG distribution has been applied to insurance claim estimates, precipitation levels, COVID-19 mortality rates, and accident frequencies. The present study examines methodologies for constructing confidence intervals for the statistical parameters of the delta–IG distribution. Jana and Gautam [10] investigated confidence intervals for means, their differences, and ratios within this distribution, while Khumpasee, Niwitpong, and Niwitpong [11] studied confidence intervals for the coefficient of variation (CV) of the delta–IG. In particular, confidence intervals for the difference and the ratio of variances under delta–IG distributions have not yet been systematically investigated.

In statistics, variance quantifies the deviation from the mean. The calculation involves squaring the difference between each value in the data set and the mean, then dividing the sum of the squares by the total number of values. Furthermore, variance is the second central moment, whereas the square root of the variance is the standard deviation. In the difference-based approach, the confidence interval includes 0; the variances are considered not significantly different, whereas excluding 0 indicates a significant difference in variability. Alternatively, the ratio-based approach assesses relative variability via a confidence interval for the ratio of the two variances; a value of 1 indicates no significant difference between the variances. While the ratio-based interval provides a scale-free comparison, the difference-based interval allows for direct interpretation in terms of absolute variability, and together these approaches offer complementary perspectives for variance comparison.

Several researchers have concentrated on developing confidence intervals for the difference and ratio of variances between two data sets, employing diverse methods for various distributions. For example, Bonett [12] provided an estimated confidence interval for the ratio of variances for bivariate non-normal distributions. Bebu and Mathew [13] used the GCI method and a modified signed log-likelihood ratio method to construct a confidence interval for the variance ratio of bivariate lognormal distributions. Paksaranuwat and Niwitpong [14] evaluated the effectiveness of adaptive confidence intervals relative to typical confidence intervals for the variance and the ratio of variances in non-normal distributions with missing data. Wongyai and Suwan [15] established the confidence interval for the variance ratio of bivariate non-normal distributions with a kurtosis estimator. Kooriphan

et al. [16] constructed the confidence interval for the ratio of the variances of two delta–gamma distributions by using the fiducial quantity method, Bayesian credible intervals, and highest posterior density (HPD) intervals. Recently, Ratasukharom et al. [17] studied methods for creating confidence intervals for the difference and ratio of the variances of the Birnbaum–Saunders distributions that include zero values.

The primary objective of this paper is to develop and evaluate confidence interval methods for the difference and the ratio of two variances from independent delta–inverse Gaussian populations. Specifically, we construct confidence intervals using adjusted generalized confidence intervals (AGCIs), fiducial confidence intervals (FCIs), Bayesian credible intervals (BCIs), the method of variance estimates recovery (MOVER), and normal approximation (NA) techniques, assessed through Monte Carlo simulation studies, with a particular emphasis on coverage probability (CP) and average width (AW) under various parameter configurations and both balanced and unbalanced sample sizes. The real-data examples involving zero-inflated and skewed observations were applied with these methods. These applications are intended solely to demonstrate the applicability of the methods and to complement the simulation results.

2. The Confidence Interval for the Difference and Ratio of Variances of the Delta–IG Distribution

Let $C_{ij} = (C_{i1}, C_{i2}, \ldots, C_{im_i})$, for $i = 1, 2, j = 1, 2, \ldots, m_i$, be a non-negative random sample from a delta–inverse Gaussian (delta–IG) distribution defined as $C_{ij} \sim$ delta-IG$(\delta_i, \mu_i, \lambda_i)$, where μ_i is the mean, λ_i is the shape parameter, and δ_i is the probability of having observed a zero value. The probability density function of delta–IG has been defined as

$$f_{\text{delta}-\text{IG}}(c_{ij}; \delta_i, \mu_i, \lambda_i) = \delta_i I_{\{c_{ij}=0\}} + (1-\delta_i) I_{\{c_{ij}>0\}} \sqrt{\frac{\lambda_i}{2\pi c_{ij}^3}} exp\left[\frac{-\lambda_i (c_{ij}-\mu_i)^2}{2\mu_i^2 c_{ij}}\right], \quad (1)$$

where I denotes an indicator function, $P(C_{ij} = 0) = \delta_i$, with $\mu_i, \lambda_i > 0$. The sample comprises m_i observations, where m_i are divided into zero ($m_{i(0)}$) and nonzero observations ($m_{i(+)}$), so that $m_i = m_{i(0)} + m_{i(+)}$. Furthermore, $m_{i(0)}$ adheres to a binomial distribution, represented as $m_{i(0)} \sim Bin(m_i, \delta_i)$.

The maximum likelihood estimates (MLEs) of δ_i, μ_i, and λ_i for the distributions are expressed as $\hat{\delta}_i = m_{i(0)}/m_i$, $\hat{\mu}_i = \overline{C}_i = \frac{1}{m_{i(+)}} \sum_{j=1}^{m_{i(+)}} C_{ij}$, and $m_{i(+)} \hat{\lambda}_i^{-1} = V_i = \sum_{j=1}^{m_{i(+)}} \left(C_{ij}^{-1} - \overline{C}_i^{-1}\right)$, respectively. The expected value was $E(C_{ij}) = (1-\delta_i)\mu_i$. The variance is expressed as $Var(C) = \tau_i = \mu_i^2(1-\delta_i)\left(\frac{\mu_i}{\lambda_i} + \delta_i\right)$. Consequently, the difference and ratio of the variances are the statistics that we will compute for its interval, represented as

$$\theta = \tau_1 - \tau_2 = \mu_1^2(1-\delta_1)\left(\frac{\mu_1}{\lambda_1} + \delta_1\right) - \mu_2^2(1-\delta_2)\left(\frac{\mu_2}{\lambda_2} + \delta_2\right), \quad (2)$$

and

$$\eta = \frac{\tau_1}{\tau_2} = \frac{\mu_1^2(1-\delta_1)\left(\frac{\mu_1}{\lambda_1} + \delta_1\right)}{\mu_2^2(1-\delta_2)\left(\frac{\mu_2}{\lambda_2} + \delta_2\right)}, \quad (3)$$

respectively.

2.1. AGCI

A generalized confidence interval (GCI) is an efficient statistical method for constructing a confidence interval when conventional techniques are insufficient. Standard confidence intervals generally depend on strong assumptions, such as large sample sizes or

normality. However, GCI provides a more adaptable and stable method [18]. This approach is mainly based on a specific function referred to as the generalized pivotal quantity (GPQ). This function has been constructed so that its probability distribution remains independent of the unknown parameter being evaluated [19]. By computing thousands of values for this GPQ using a Monte Carlo simulation, we can calculate the appropriate percentiles to define the lower and upper bounds of our confidence interval. This approach allows GCI to deliver accurate coverage probabilities, even with small sample sizes or complex parameters in non-standard distributions, making it an essential tool for contemporary data analysis across several fields, including biostatistics and engineering [20].

Ye, Ma, and Wang [21] introduced a method for computing confidence intervals for the mean of the inverse Gaussian distribution over many populations utilizing the GPQ technique.

The GPQs for λ and μ, as formulated by Ye, Ma, and Wang, are expressed as follows:

$$G_{\lambda_i} = \frac{m_{i(+)}\lambda_i V_i}{m_{i(+)}v_i} \sim \frac{\chi^2_{m_{i(+)}-1}}{m_{i(+)}v_i}, i = 1, 2, \tag{4}$$

where $\chi^2_{m_{i(+)}-1}$ is a Chi-square distribution with $m_{i(+)} - 1$ degrees of freedom, $i = 1, 2$ and

$$G_{\mu_i} = \frac{\overline{C}_i}{\left|1 + \frac{\sqrt{m_{i(+)}\lambda_i}(\overline{C}_i - \mu_i)}{\mu_i\sqrt{\overline{C}_i}}\sqrt{\frac{\overline{C}_i}{m_{i(+)}G_{\lambda_i}}}\right|} \sim \frac{\overline{C}_i}{\left|1 + Z_i\sqrt{\frac{\overline{C}_i}{m_{i(+)}G_{\lambda_i}}}\right|}, \tag{5}$$

where Z_i is approximately distributed as a standard normal distribution, denoted as $N(0, 1)$.

This work employed the variance-stabilizing transformation (VST) procedure to estimate the parameter δ_i, as recommended by an earlier study conducted by Khumpasee, Niwitpong, and Niwitpong [22], which suggested the VST technique over other methods. This method was first presented by Dasgupta [23], utilizing the normal approximation. Wu and Hsieh [24] proposed the VST for a binomial distribution, utilizing the arcsine square root transformation for approximation. Thus, the GPQ for δ_i can be expressed as

$$G_{\delta_i} = sin^2\left[arcsin\sqrt{\hat{\delta}_i} - \frac{T}{2\sqrt{m_i}}\right], \tag{6}$$

where $T = 2\sqrt{m_i}\left(arcsin\sqrt{\hat{\delta}_i} - arcsin\sqrt{\delta_i}\right) \sim N(0, 1)$, $m_i \to \infty$.

Following the application of the GCI approach to determine confidence intervals for IG distributions, an additional generalized pivotal quantity for the parameter μ was identified, as suggested by Krishnamoorthy and Tian [25], and called the AGCI method. This AGCI technique will utilize the GPQ of parameter μ instead of the GPQ for parameter μ, as specified in Equation (5) of the GCI method. The GPQ for the parameter μ, as proposed by Krishnamoorthy and Tian, is defined as

$$G_{\widetilde{\mu}_i} = \frac{\overline{C}_i}{max\left\{0, 1 + t_{m_{i(+)}-1}\sqrt{\frac{\overline{C}_i v_i}{m_{i(+)}-1}}\right\}}, \tag{7}$$

where $t_{m_{i(+)}-1}$ is Student's t distribution, with $m_{i(+)} - 1$ degrees of freedom.

Consequently, from the GPQ of the parameters, we obtain G_{λ_i}, $G_{\widetilde{\mu}_i}$, and G_{δ_i}, articulated as Equations (4), (7) and (6), respectively. The GPQ for θ is defined as

$$G_{\widetilde{\theta}} = G^2_{\widetilde{\mu}_1}(1 - G_{\delta_1})\left(\frac{G_{\widetilde{\mu}_1}}{G_{\lambda_1}} + G_{\delta_1}\right) - G^2_{\widetilde{\mu}_2}(1 - G_{\delta_2})\left(\frac{G_{\widetilde{\mu}_2}}{G_{\lambda_2}} + G_{\delta_2}\right), \tag{8}$$

and the GPQ for η can be defined as

$$G_{\widetilde{\eta}} = \frac{G_{\widetilde{\mu}_1}^2 \left(1 - G_{\delta_1}\right)\left(\frac{G_{\widetilde{\mu}_1}}{G_{\lambda_1}} + G_{\delta_1}\right)}{G_{\widetilde{\mu}_2}^2 \left(1 - G_{\delta_2}\right)\left(\frac{G_{\widetilde{\mu}_2}}{G_{\lambda_2}} + G_{\delta_2}\right)}. \tag{9}$$

The $100(1-\alpha)\%$ two-sided confidence interval for θ via the AGCI approach is

$$CI_{\theta}^{\text{AGCI}} = \left[L_{\theta}^{AGCI}, U_{\theta}^{AGCI}\right] = \left[G_{\widetilde{\theta}}(\alpha/2), G_{\widetilde{\theta}}(1-\alpha/2)\right], \tag{10}$$

where $G_{\widetilde{\theta}}(\alpha/2)$ and $G_{\widetilde{\theta}}(1-\alpha/2)$ are the $100_{\frac{\alpha}{2}}$-th and $100_{(1-\frac{\alpha}{2})}$-th percentiles of the distribution of $G_{\widetilde{\theta}}$, respectively.

And the $100(1-\alpha)\%$ two-sided CI for η using the AGCI method is

$$CI_{\eta}^{\text{AGCI}} = \left[L_{\eta}^{AGCI}, U_{\eta}^{AGCI}\right] = \left[G_{\widetilde{\eta}}(\alpha/2), G_{\widetilde{\eta}}(1-\alpha/2)\right], \tag{11}$$

where $G_{\widetilde{\eta}}(\alpha/2)$ and $G_{\widetilde{\eta}}(1-\alpha/2)$ are the $100_{\frac{\alpha}{2}}$-th and $100_{(1-\frac{\alpha}{2})}$-th percentiles of the distribution of $G_{\widetilde{\eta}}$, respectively. The AGCI method is described in Algorithm 1.

Algorithm 1: AGCI

1. Construct random variable $C_{ij} = \left(C_{i1}, C_{i2}, \ldots, C_{im_i}\right)$, for $i = 1, 2, j = 1, 2, \ldots, m_i$ from $C_{ij} \sim \text{delta}-\text{IG}(\delta_i, \mu_i, \lambda_i)$, then calculate for $\hat{\delta}_i$, $\hat{\mu}_i$, and $\hat{\lambda}_i$.
2. Produce $\chi^2_{m_{i(+)}-1}$ and $t_{m_{i(+)}-1}$ from Chi-square and the Student's t distributions, respectively.
3. Calculate G_{λ_i}, $G_{\widetilde{\mu}_i}$, and G_{δ_i} using Equations (4), (7) and (6), respectively.
4. Reiterate steps 1–3 for k = 1, 2, …, 5000 times to acquire $CI_{\theta}^{\text{AGCI}}$ and CI_{η}^{AGCI} as (10) and (11).

2.2. FCI

Fiducial confidence intervals in estimation include constructing a probability distribution for an unknown variable depending directly on observable data. This approach is executed without utilizing prior distributions in repeated sampling. This method was outlined by Fisher [26]. The core concept of this approach is to construct a "fiducial distribution" for an unknown parameter, derived by inverting a probability statement for a pivotal quantity. The confidence interval is directly obtained from the percentiles of the fiducial distribution. This interval resembles a Bayesian confidence interval but does not require objective or subjective priors.

The Gibbs sampling method, as articulated by Geman & Geman [27], is an appropriate technique for fiducial inference. The sample distributions of the maximum likelihood estimate for the parameters δ_i, μ_i, and λ_i are employed in the delta–inverse Gaussian distribution. The fiducial distribution for the parameters μ_i and λ_i may be derived by substituting their maximum likelihood estimates (MLEs). In the sample distribution, the parameters are distributed as $\mu_i \sim IG\left(\hat{\mu}_i, m_{i(+)}\hat{\lambda}_i\right)$ and $\lambda_i \sim \left(\hat{\lambda}_i / m_{i(+)}\right)\chi^2_{m_{i(+)}-1}$, with $\hat{\mu}_i$ and $\hat{\lambda}_i$ being the MLEs of μ_i and λ_i, respectively. The FCI approach will utilize VST methods to estimate the parameter δ_i.

The $100(1-\alpha)\%$ two-sided confidence interval for θ and η in the delta–IG distribution, derived using the FCI approach using Algorithm 2, is defined as

$$CI_{\theta}^{\text{FCI}} = \left[G_{\theta}^{\text{FCI}}(\alpha/2), G_{\theta}^{\text{FCI}}(1-\alpha/2)\right], \tag{12}$$

and

$$CI_{\eta}^{\mathrm{FCI}} = \left[G_{\eta}^{\mathrm{FCI}}(\alpha/2), G_{\eta}^{\mathrm{FCI}}(1-\alpha/2)\right], \tag{13}$$

respectively.

Algorithm 2: FCI

1. Set the initial estimates (MLEs) of parameters $\left(\mu_i{}^{(0)}, \lambda_i{}^{(0)}\right)$
2. Generate $\mu_i{}^{(t)} \sim IG\left(\hat{\mu}_i^{(t-1)}, m_{i(+)}\hat{\lambda}_i^{(t-1)}\right)$ and $\lambda_i{}^{(t)} \sim (\hat{\lambda}_i^{(t-1)}/m_{i(+)})\chi^2_{m_{i(+)}-1}$.
3. Reiterate step 2 for t = 1, 2, . . ., 20,000 times for replications of MCMC.
4. Burn in 1000 samples and calculate the interest parameter.
5. Acquire $CI_{\theta}^{\mathrm{FCI}}$ and CI_{η}^{FCI} using (12) and (13).

2.3. BCI

A Bayesian credible interval is an interval of values for an unknown parameter derived using the Bayesian method. The credible interval is obtained from the posterior distribution, which reflects the updated probability distribution of the parameter after incorporating the prior distribution and the likelihood function from observed random sample data using Bayes' theorem. To derive the posterior density function for the parameter estimation of delta–IG, the probability function of delta–IG must be integrated with the prior density function. The choice of the prior is a critical element of this approach, as it can markedly affect the resulting interval, particularly with limited sample sizes. The likelihood function of the delta–IG distribution is expressed as

$$L(\theta|\underline{C}_i) \propto \delta_i{}^{m_{i(0)}}(1-\delta_i)^{m_{i(1)}}\lambda_i^{m_{i(1)}/2}\exp\left(-\frac{\lambda_i}{2\mu_i^2}(t_1 - 2n_1\mu_i + t_2\mu_i^2)\right), \tag{14}$$

where $t_1 = \sum_{j=1}^{m_i} C_{ij}$, and $t_2 = \sum_{j=1}^{m_i} C_{ij}^{-1}$, $i = 1, 2$.

The posterior density of θ is expressed as

$$f(\theta|\underline{H}_i) \propto f(\theta)L(\theta|\underline{H}_i). \tag{15}$$

Nonetheless, the posterior distributions derived from the delta–IG distribution can be complicated to understand. Accordingly, we executed the Markov Chain Monte Carlo simulation (MCMC) using Gibbs sampling to estimate the parameters. We utilized the MCMC simulation to calculate the interest parameters, applying a uniform prior for μ, a gamma prior for λ, and a beta prior for δ. This method was computed using the R2OpenBUGS package in the R (version 4.2.1) programming language.

The $100(1-\alpha)$% two-sided confidence intervals (CIs) for θ and η in the delta–IG distribution, derived using the BCI approach via Algorithm 3, are defined as follows:

$$CI_{\theta}^{\mathrm{BCI}} = [G_{\theta}^{\mathrm{BCI}}(\alpha/2), G_{\theta}^{\mathrm{BCI}}(1-\alpha/2)], \tag{16}$$

and

$$CI_{\eta}^{\mathrm{BCI}} = [G_{\eta}^{\mathrm{BCI}}(\alpha/2), G_{\eta}^{\mathrm{BCI}}(1-\alpha/2)], \tag{17}$$

respectively.

Algorithm 3: BCI

1. Produce random variable $C_{ij} = (C_{i1},\ C_{i2}, \ldots, C_{im_i})$, for $i = 1,\ 2,\ j = 1,\ 2, \ldots, m_i$ from $C_{ij} \sim$ delta$-$IG$(\delta_i, \mu_i, \lambda_i)$.
2. Specify the prior distribution of each parameter as $\mu_i \sim$ uniform(a, b), $\lambda_i \sim$ gamma(α_1, β_1), and $\delta_i \sim$ beta(α_2, β_2) using trial hyperparameters.
3. Implement Gibbs sampling in R programming to derive the posterior distribution for three parameters $(\delta_i, \mu_i, \lambda_i)$.
4. Estimate the interest parameters $\hat{\theta}$ and $\hat{\eta}$.
5. Reiterate steps 3 and 4 for 20,000 times.
6. Conduct a burn-in of 5000 samples.
7. Obtain $CI_{\theta}^{\mathrm{BCI}}$ and CI_{η}^{BCI} using (16) and (17).

2.4. MOVER

The method of variance estimates recovery (MOVER) was proposed by Zou and Donner [28]. MOVER is a versatile and efficient method for constructing confidence intervals for different parameters, particularly for the difference or ratio of two independent variables. It is especially beneficial in situations where traditional large-scale methods may be inadequate, such as with small sample sizes or skewed distributions.

The fundamental concept of MOVER is to estimate or retrieve the variance of a parameter based on predefined confidence levels. For a given parameter, the lower confidence limit (L) and upper confidence limit (U) may be used to obtain two separate variance estimates: one based on the distance from the point estimate to the lower limit, and the other based on the distance to the upper limit. By integrating these recovered variances with the point estimates of the individual parameters, the MOVER approach can establish an integrated confidence interval for the aggregated parameter (e.g., the difference or ratio). This approach is particularly advantageous, since it accounts for asymmetry in the underlying distributions, yielding more accurate and robust confidence intervals.

The MOVER method delineates the lower and upper confidence limits for the difference between two parameters, or $\theta = \tau_1 - \tau_2$, represented as follows:

$$L_{diff} = \hat{\tau}_1 - \hat{\tau}_2 - \sqrt{(\hat{\tau}_1 - l_1)^2 + (u_2 - \hat{\tau}_2)^2}, \tag{18}$$

and

$$U_{diff} = \hat{\tau}_1 - \hat{\tau}_2 + \sqrt{(u_1 - \hat{\tau}_1)^2 + (\hat{\tau}_2 - l_2)^2}, \tag{19}$$

where (l_1, u_1) and (l_2, u_2) are $100(1-\alpha)\%$ confidence limits for the parameters τ_1 and τ_2.

The MOVER technique delineates the lower and upper confidence bounds for the ratio of two parameters, $\eta = \tau_1/\tau_2$, articulated as follows:

$$L_{ratio} = \frac{\hat{\tau}_1\hat{\tau}_2 - \sqrt{(\hat{\tau}_1\hat{\tau}_2)^2 - l_1u_2(2\hat{\tau}_1 - l_2)(2\hat{\tau}_2 - u_2)}}{u_2(2\hat{\tau}_2 - u_2)}, \tag{20}$$

and

$$U_{ratio} = \frac{\hat{\tau}_1\hat{\tau}_2 + \sqrt{(\hat{\tau}_1\hat{\tau}_2)^2 - u_1l_2(2\hat{\tau}_1 - u_1)(2\hat{\tau}_2 - l_2)}}{l_2(2\hat{\tau}_2 - l_2)}, \tag{21}$$

where (l_1, u_1) and (l_2, u_2) are $100(1-\alpha)\%$ confidence limits for the parameters τ_1 and τ_2.

Utilizing confidence intervals derived from the AGCI technique, as delineated in Equations (8) and (9), we obtain the $100(1-\alpha)\%$ two-sided confidence intervals for $\theta = \tau_1 - \tau_2$ and $\eta = \tau_1/\tau_2$, as shown below.

According to the AGCI technique, the GPQ for θ is defined as

$$G_{\widetilde{\theta}} = G_{\widetilde{\mu}_1}^2(1-G_{\delta_1})\left(\frac{G_{\widetilde{\mu}_1}}{G_{\lambda_1}}+G_{\delta_1}\right)-G_{\widetilde{\mu}_2}^2(1-G_{\delta_2})\left(\frac{G_{\widetilde{\mu}_2}}{G_{\lambda_2}}+G_{\delta_2}\right), \tag{22}$$

and the GPQ for η can be defined as

$$G_{\widetilde{\eta}} = \frac{G_{\widetilde{\mu}_1}^2(1-G_{\delta_1})\left(\frac{G_{\widetilde{\mu}_1}}{G_{\lambda_1}}+G_{\delta_1}\right)}{G_{\widetilde{\mu}_2}^2(1-G_{\delta_2})\left(\frac{G_{\widetilde{\mu}_2}}{G_{\lambda_2}}+G_{\delta_2}\right)}. \tag{23}$$

The $100(1-\alpha)\%$ two-sided CI for θ using the AGCI method is

$$CI_{\theta}^{\text{AGCI}} = [L_{\theta}^{AGCI}, U_{\theta}^{AGCI}] = [G_{\widetilde{\theta}}(\alpha/2), G_{\widetilde{\theta}}(1-\alpha/2)]. \tag{24}$$

And the $100(1-\alpha)\%$ two-sided CI for η using the AGCI method is

$$CI_{\eta}^{\text{AGCI}} = [L_{\eta}^{AGCI}, U_{\eta}^{AGCI}] = [G_{\widetilde{\eta}}(\alpha/2), G_{\widetilde{\eta}}(1-\alpha/2)]. \tag{25}$$

Therefore, the $100(1-\alpha)\%$ two-sided confidence intervals for θ and η derived using the MOVER approach via Algorithm 4 are expressed as

$$\left[L_{\theta}^{MOVER}, U_{\theta}^{MOVER}\right] = \left[\hat{\tau}_1-\hat{\tau}_2-\sqrt{(\hat{\tau}_1-l_1)^2+(u_2-\hat{\tau}_2)^2}, \hat{\tau}_1-\hat{\tau}_2+\sqrt{(u_1-\hat{\tau}_1)^2+(\hat{\tau}_2-l_2)^2}\right], \tag{26}$$

and

$$\left[L_{\eta}^{MOVER}, U_{\eta}^{MOVER}\right] = \left[\frac{\hat{\tau}_1\hat{\tau}_2-\sqrt{(\hat{\tau}_1\hat{\tau}_2)^2-l_1u_2(2\hat{\tau}_1-l_2)(2\hat{\tau}_2-u_2)}}{u_2(2\hat{\tau}_2-u_2)}, \frac{\hat{\tau}_1\hat{\tau}_2+\sqrt{(\hat{\tau}_1\hat{\tau}_2)^2-u_1l_2(2\hat{\tau}_1-u_1)(2\hat{\tau}_2-l_2)}}{l_2(2\hat{\tau}_2-l_2)}\right]. \tag{27}$$

Algorithm 4: MOVER

1. Produce random variable $C_{ij} = (C_{i1}, C_{i2}, \ldots, C_{im_i})$, for $i = 1, 2, j = 1, 2, \ldots, m_i$ from $C_{ij} \sim \text{delta}-\text{IG}(\delta_i, \mu_i, \lambda_i)$, then compute for $\hat{\delta}_i$, $\hat{\mu}_i$, and $\hat{\lambda}_i$.
2. Generate $\chi^2_{m_{i(+)}-1}$ and $t_{m_{i(+)}-1}$ from Chi-square and the Student's t distributions, respectively.
3. Calculate G_{λ_i}, $G_{\widetilde{\mu}_i}$, and G_{δ_i} using Equations (4), (7) and (6), respectively.
4. Calculate the confidence intervals of θ and η from the AGCI method using Equations (24) and (25).
5. Compute $[L_{\theta}^{MOVER}, U_{\theta}^{MOVER}]$ and $[L_{\eta}^{MOVER}, U_{\eta}^{MOVER}]$ from Equations (26) and (27).
6. Reiterate steps 1–5 for k = 1, 2, . . ., 5000 times.

2.5. NA

In the normal approximation method, we utilize the delta method to show that the estimator τ has a normal distribution as the limiting distribution. This approach relies on large-sample theory and serves as a conventional benchmark due to its analytical simplicity and closed-form implementation. However, it is well established in the literature that confidence intervals based on normal approximations can perform poorly for skewed distributions, particularly in finite samples, and are often outperformed by bootstrap-based or modified methods [29]. This method may be briefly outlined as follows:

Let $u(v_1,\ v_2,\ v_3)$ be a differentiable scalar function of three variables. An estimator, $U = u(v_1,\ v_2,\ v_3)$, depends on three parameters: V_1, V_2, and V_3. Using the delta method, we may determine the asymptotic distribution of U, which requires providing a stochastic representation of U. We employ the delta method to illustrate the asymptotic normality of U as sample sizes approach infinity and to compute the asymptotic mean and variance of the estimators τ. In the delta method, the function u is expressed as a Taylor series at the points φ_1, φ_2, φ_3 of V_1, V_2, V_3 as follows:

$$u(v_1, v_2, v_3) \approx u(\varphi_1, \varphi_2, \varphi_3) + \frac{\partial u(\varphi_1, \varphi_2, \varphi_3)}{\partial v_1}(V_1 - \varphi_1) + \frac{\partial u(\varphi_1, \varphi_2, \varphi_3)}{\partial v_2}(V_2 - \varphi_2) + \frac{\partial u(\varphi_1, \varphi_2, \varphi_3)}{\partial v_3}(V_3 - \varphi_3). \tag{28}$$

The essential statistics are denoted as $V_1 = \hat{\mu}$, $V_2 = \hat{\lambda}$, and $V_3 = \hat{\delta}$, where $\hat{\mu}$, $\hat{\lambda}$, and $\hat{\delta}$ signify the maximum likelihood estimates of μ, λ, and δ, respectively. Consequently, $\hat{\tau} = u\left(\hat{\mu},\ \hat{\lambda},\ \hat{\delta}\right)$, where the function $u(\mu, \lambda, \delta)$ is articulated as $\mu^2(1-\delta)\left(\frac{\mu}{\lambda} + \delta\right)$. The partial derivatives are listed as follows.

$$\frac{\partial \mathrm{u}(\mu, \lambda, \delta)}{\partial \mu} = (1-\delta)\left[\mu^2\left(\frac{1}{\lambda}\right) + \left(\frac{\mu}{\lambda} + \delta\right)2\mu\right].$$

$$\frac{\partial \mathrm{u}(\mu, \lambda, \delta)}{\partial \lambda} = \mu^2(1-\delta)\left(-\frac{\mu}{\lambda^2}\right).$$

$$\frac{\partial u(\mu, \lambda, \delta)}{\partial \delta} = \mu^2\left[(1-\delta) - \left(\frac{\mu}{\lambda} + \delta\right)\right].$$

Thus,

$$\begin{aligned} \hat{\tau} \approx\ & u(\mu, \lambda, \delta) + \tfrac{\partial u(\mu,\lambda,\delta)}{\partial \mu}(\hat{\mu} - \mu) + \tfrac{\partial u(\mu,\lambda,\delta)}{\partial \lambda}\left(\hat{\lambda} - \lambda\right) + \tfrac{\partial u(\mu,\lambda,\delta)}{\partial \delta}\left(\hat{\delta} - \delta\right) \\ =\ & f(\mu, \lambda, \delta) + (1-\delta)\left[\mu^2\left(\tfrac{1}{\lambda}\right) + \left(\tfrac{\mu}{\lambda} + \delta\right)2\mu\right](\hat{\mu} - \mu) + \mu^2(1-\delta)\left(-\tfrac{\mu}{\lambda^2}\right)\left(\hat{\lambda} - \lambda\right) + \\ & \mu^2\left[(1-\delta) - \left(\tfrac{\mu}{\lambda} + \delta\right)\right]\left(\hat{\delta} - \delta\right). \end{aligned} \tag{29}$$

Taking the expectation and variance in Equation (29), the estimated mean and variance for $\hat{\tau}$ are expressed as

$$E(\hat{\tau}) = \tau. \tag{30}$$

$$\begin{aligned} Var(\hat{\tau}) \approx\ & Var\{f(\mu, \lambda, \delta) + (1-\delta)\left[\mu^2\left(\tfrac{1}{\lambda}\right) + \left(\tfrac{\mu}{\lambda} + \delta\right)2\mu\right](\hat{\mu} - \mu) + \\ & \mu^2(1-\delta)\left(-\tfrac{\mu}{\lambda^2}\right)\left(\hat{\lambda} - \lambda\right) + \mu^2\left[(1-\delta) - \left(\tfrac{\mu}{\lambda} + \delta\right)\right]\left(\hat{\delta} - \delta\right)\} \\ =\ & \left\{(1-\delta)\left[\mu^2\left(\tfrac{1}{\lambda}\right) + \left(\tfrac{\mu}{\lambda} + \delta\right)2\mu\right]\right\}^2\left(\tfrac{\mu^3}{\lambda m_{i(+)}}\right) + \left\{\mu^2(1-\delta)\left(-\tfrac{\mu}{\lambda^2}\right)\right\}^2\left(\tfrac{2\lambda^2}{m_{i(+)}}\right) + \\ & \left\{\mu^2\left[(1-\delta) - \left(\tfrac{\mu}{\lambda} + \delta\right)\right]\right\}^2\left(\tfrac{\delta(1-\delta)}{m_i}\right). \end{aligned} \tag{31}$$

Consequently, when $m_i \to \infty$, $\hat{\tau}$ approximates a normal distribution, denoted as $N(E(\hat{\tau}), Var(\hat{\tau}))$. The values of μ, λ, and δ are uncertain when estimating the parameter function τ solely from the available samples. Thereafter, we utilize the plug-in estimators for $E(\hat{\tau}_i)$ and $Var(\hat{\tau}_i)$, as shown below.

$$E(\hat{\tau}_i) = \hat{\mu}_i^2(1-\hat{\delta}_i)\left(\frac{\hat{\mu}_i}{\hat{\lambda}_i} + \hat{\delta}_i\right), \tag{32}$$

$$Var(\hat{\tau}_i) = \left\{(1-\hat{\delta}_i)\left[\hat{\mu}_i^2\left(\frac{1}{\hat{\lambda}_i}\right) + \left(\frac{\hat{\mu}_i}{\hat{\lambda}_i} + \hat{\delta}_i\right)2\hat{\mu}_i\right]\right\}^2\left(\frac{\hat{\mu}_i^3}{\hat{\lambda}_i m_{i(+)}}\right) + \left\{\hat{\mu}_i^2(1-\hat{\delta}_i)\left(-\frac{\hat{\mu}_i}{\hat{\lambda}_i^2}\right)\right\}^2\left(\frac{2\hat{\lambda}_i^2}{m_{i(+)}}\right) + \left\{\hat{\mu}_i^2\left[(1-\hat{\delta}_i) - \left(\frac{\hat{\mu}_i}{\hat{\lambda}_i} + \hat{\delta}_i\right)\right]\right\}^2\left(\frac{\hat{\delta}_i(1-\hat{\delta}_i)}{m_i}\right). \quad (33)$$

The estimated variance of the estimated difference between two variances of delta–IG may be articulated as follows:

$$Var(\hat{\theta}) = Var(\hat{\tau}_1) + Var(\hat{\tau}_2), \quad (34)$$

where $\text{cov}(\hat{\tau}_1\hat{\tau}_2) = 0$.

The estimated variance of the estimated ratio between two variances of delta–IG can be articulated as follows:

$$Var(\hat{\eta}) = Var(\hat{\tau}_1) + Var(\hat{\tau}_2), \quad (35)$$

where $\text{cov}(\hat{\tau}_1\hat{\tau}_2) = 0$.

The $100(1-\alpha)\%$ confidence interval for θ using normal approximation is

$$CI_\theta^{\text{NA}} = (\hat{\tau}_1 - \hat{\tau}_2) \pm z_{1-\frac{\alpha}{2}}\sqrt{Var(\hat{\theta})}, \quad (36)$$

where $z_{1-\frac{\alpha}{2}}$ is the $(1-\frac{\alpha}{2})$th percentile of the standard normal distribution.

The $100(1-\alpha)\%$ confidence interval for η using normal approximation is

$$CI_\eta^{\text{NA}} = (\hat{\tau}_1/\hat{\tau}_2) \pm z_{1-\frac{\alpha}{2}}\sqrt{Var(\hat{\eta})}, \quad (37)$$

where $z_{1-\frac{\alpha}{2}}$ is the $(1-\frac{\alpha}{2})$th percentile of the standard normal distribution. The algorithms of the forementioned methods require iterative procedures because the corresponding confidence intervals do not admit closed-form expressions. In contrast, the algorithm of the normal approximation has an explicit closed-form solution and therefore does not require iteration, which is shown in Algorithm 5.

Algorithm 5: NA

1. Conduct random variable $C_{ij} = (C_{i1}, C_{i2}, \ldots, C_{im_i})$, for $i = 1, 2, j = 1, 2, \ldots, m_i$ from $C_{ij} \sim \text{delta}-\text{IG}(\delta_i, \mu_i, \lambda_i)$, then calculate for the MLEs of $\delta_i, \mu_i, \lambda_i$ as $\hat{\delta}_i, \hat{\mu}_i$, and $\hat{\lambda}_i$, respectively.
2. Using the estimated MLEs $\hat{\delta}_i, \hat{\mu}_i$, and $\hat{\lambda}_i$ to compute τ_i, then obtain $\hat{\tau}_i$.
3. Compute the $100(1-\alpha)\%$ NA confidence intervals for θ and η by using Equations (36) and (37).

3. Results

The performance of five confidence interval methods for the difference and the ratio of two variances under delta–inverse Gaussian (delta–IG) distributions was investigated. Monte Carlo simulation was employed because the analytical derivation of exact or asymptotic coverage probabilities for variance differences and ratios in the presence of zero inflation and nonlinear variance structures is analytically intractable. The simulation therefore provides a practical and reliable framework for evaluating finite-sample performance. The parameter configurations are selected to represent a wide range of zero-inflation levels and dispersion characteristics commonly encountered in practice. All simulations were implemented in the R programming language. The methods were evaluated in terms of coverage probabilities (CPs) and average widths (AWs). A confidence interval method is considered satisfactory if its CP is close to or exceeds the nominal confidence level of

0.95, while maintaining relatively narrow interval widths. The simulation is performed for 5000 iterations. Sample data for the difference and ratio of two variances of the delta–IG distribution have been generated from $C_{ij} = (C_{i1}, C_{i2}, \ldots, C_{im_i})$, for $i = 1, 2, j = 1, 2, \ldots, m_i$ from $C_{ij} \sim$ delta-IG$(\delta_i, \mu_i, \lambda_i)$ distributions. Both balanced and unbalanced sample sizes were considered, with (m_1, m_2) being (30, 30), (50, 50), (100, 100), (200, 200), (30, 50), (50, 100), and (100, 200). The mean parameters (μ_1, μ_2) are (0.5, 0.5), (0.5, 1.0), and (1.0, 1.0). The shape parameters (λ_1, λ_2) were established as (1, 1), (1, 5), (5, 5), (5, 10), and (10, 10). The probabilities of zero values (δ_1, δ_2) were established as (0.3, 0.3), (0.3, 0.5), and (0.5, 0.5).

The graphical results illustrate the coverage probabilities (CPs) and average widths (AWs) of confidence intervals for the difference and ratio of two variances of delta–inverse Gaussian distributions under various balanced and unbalanced sample sizes. Figures 1 and 2 present the CPs and AWs for the difference in variances, while Figures 3 and 4 correspond to the ratio of variances. These figures are constructed based on the numerical results reported in Tables 1–14.

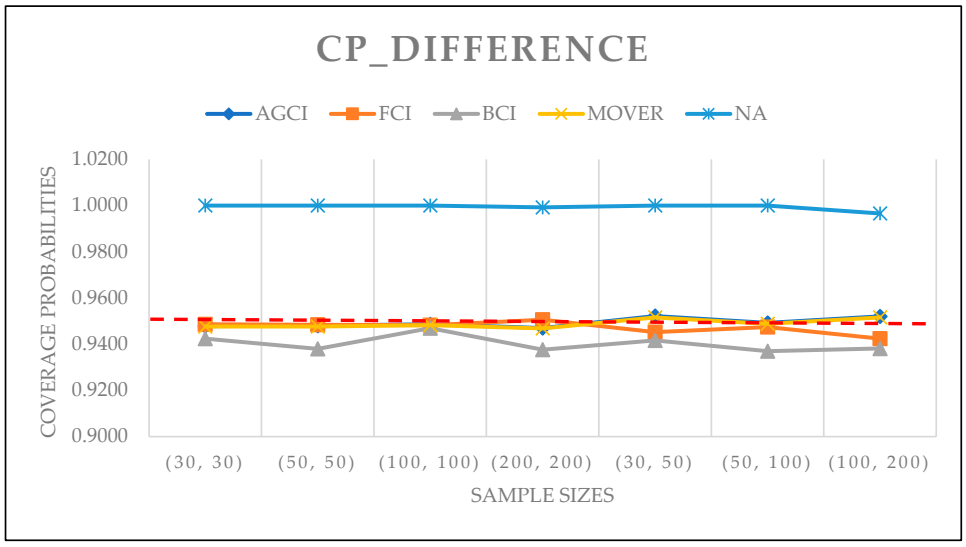


Figure 1. Comparison of coverage probabilities of CIs for the difference in two variances from the proposed methods with various sample sizes at $(\delta_1, \delta_2, \mu_1, \mu_2, \lambda_1, \lambda_2)$ = (0.3, 0.3, 1.0, 1.0, 1.0, 1.0), the red dashed line means the CP equals to 0.95.

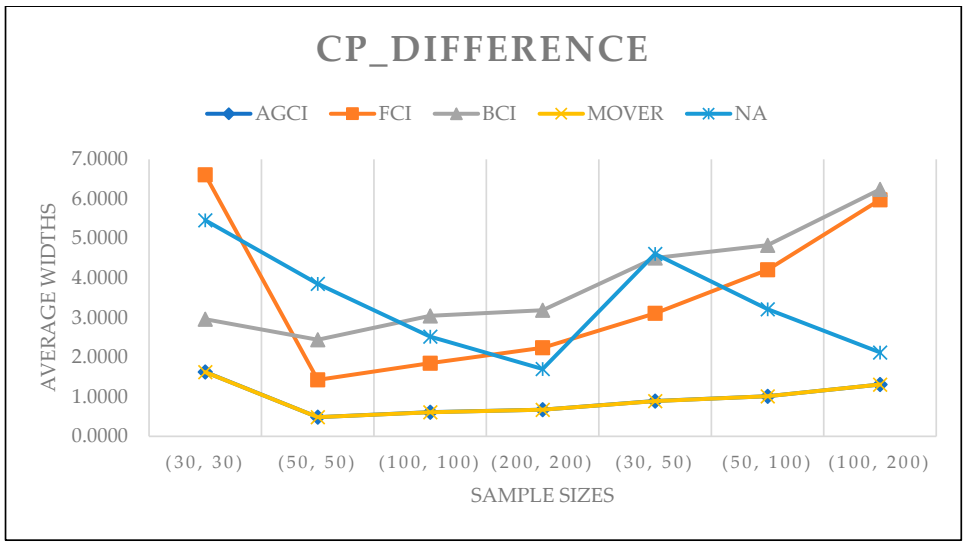


Figure 2. Comparison of average widths of CIs for the difference in two variances from the proposed methods with various sample sizes at $(\delta_1, \delta_2, \mu_1, \mu_2, \lambda_1, \lambda_2)$ = (0.3, 0.3, 1.0, 1.0, 1.0, 1.0).

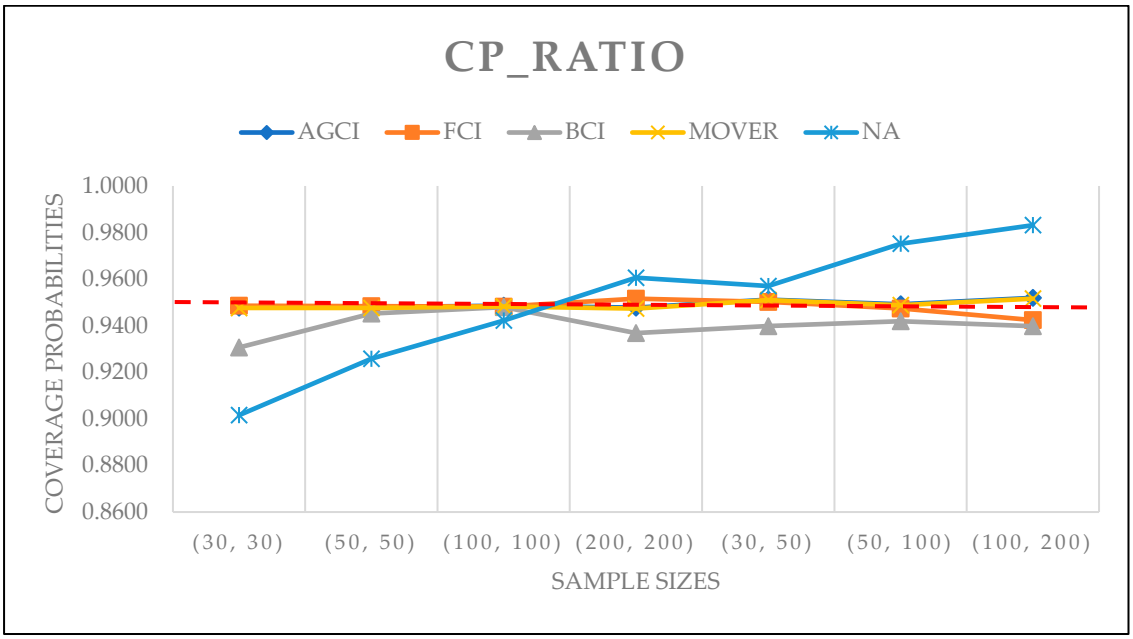


Figure 3. Comparison of coverage probabilities of CIs for the ratio of two variances from the proposed methods with various sample sizes at $(\delta_1, \delta_2, \mu_1, \mu_2, \lambda_1, \lambda_2)$ = (0.3, 0.3, 1.0, 1.0, 1.0, 1.0), the red dashed line means the CP equals to 0.95.

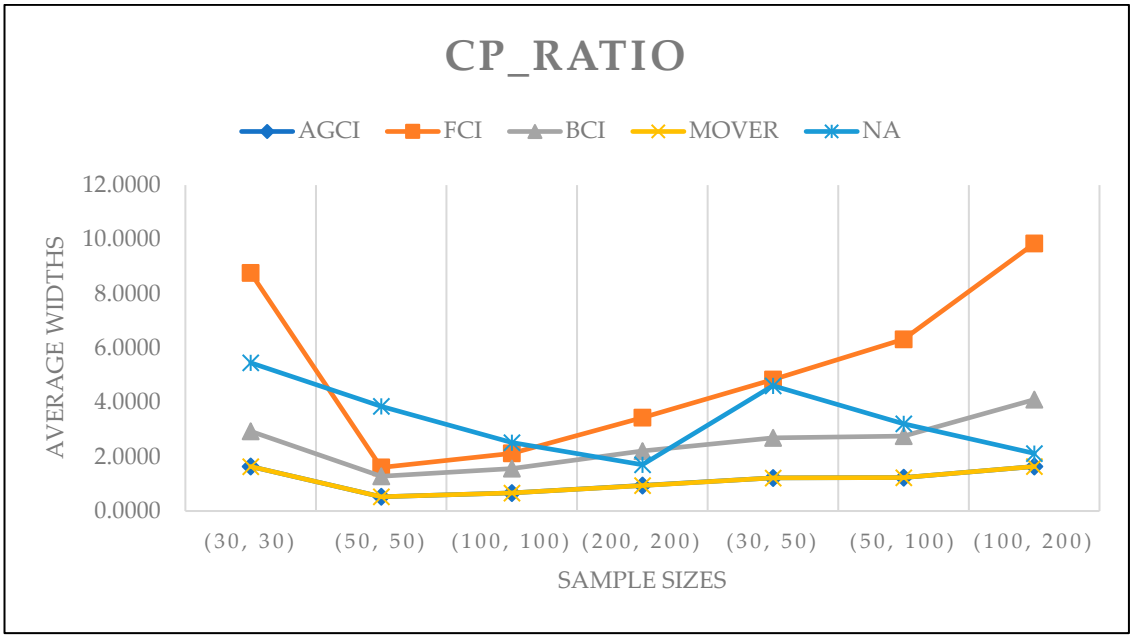


Figure 4. Comparison of average widths of CIs for the ratio of two variances from the proposed methods with various sample sizes at $(\delta_1, \delta_2, \mu_1, \mu_2, \lambda_1, \lambda_2)$ = (0.3, 0.3, 1.0, 1.0, 1.0, 1.0).

Table 1. The coverage probabilities and average widths of the 95% confidence intervals for the difference in variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (30, 30).

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
30	30	0.5	0.5	1	1	0.3	0.3	0.9436	**0.9522**	**0.9560**	0.9434	**1.0000**	0.2032	0.5358	0.9134	0.2029	***0.5054***
30	30	0.5	0.5	1	1	0.3	0.5	**0.9508**	**0.9462**	0.9416	**0.9508**	**1.0000**	0.1385	0.3497	0.6884	***0.1383***	0.6020
30	30	0.5	0.5	1	1	0.5	0.5	**0.9540**	**0.9496**	0.9418	**0.9538**	**1.0000**	0.0896	0.2191	0.4222	***0.0895***	0.6900
30	30	0.5	0.5	1	5	0.3	0.3	**0.9444**	0.9306	0.9354	0.9438	0.9212	***0.1380***	0.3443	0.6670	0.1378	0.3468
30	30	0.5	0.5	1	5	0.3	0.5	**0.9482**	0.9334	0.9435	**0.9480**	**0.9458**	0.0960	0.2314	0.4776	***0.0959***	0.3553
30	30	0.5	0.5	1	5	0.5	0.5	**0.9526**	**0.9464**	0.9453	**0.9526**	**0.9644**	0.0633	0.1509	0.3066	***0.0632***	0.4688
30	30	0.5	0.5	5	5	0.3	0.3	**0.9466**	**0.9500**	0.9432	**0.9460**	**0.9966**	***0.0406***	0.0784	0.2052	***0.0406***	0.0990
30	30	0.5	0.5	5	5	0.3	0.5	**0.9514**	0.9432	0.9441	**0.9512**	**0.9990**	***0.0277***	0.0567	0.1335	***0.0277***	0.1257
30	30	0.5	0.5	5	5	0.5	0.5	**0.9514**	**0.9470**	0.9431	**0.9512**	**0.9996**	***0.0179***	0.0385	0.0874	***0.0179***	0.1501
30	30	0.5	0.5	5	10	0.3	0.3	**0.9452**	0.9446	**0.9466**	**0.9450**	**0.9868**	0.0314	0.0622	0.1482	***0.0313***	0.0840
30	30	0.5	0.5	5	10	0.3	0.5	**0.9522**	0.9424	0.9353	**0.9522**	**0.9968**	0.0216	0.0454	0.1067	***0.0215***	0.0970
30	30	0.5	0.5	5	10	0.5	0.5	**0.9564**	0.9430	0.9408	**0.9562**	**0.9988**	***0.0140***	0.0311	0.0713	***0.0140***	0.1244
30	30	0.5	0.5	10	10	0.3	0.3	0.9448	0.9448	0.9386	0.9446	**0.9870**	0.0203	0.0422	0.1001	0.0203	***0.0682***
30	30	0.5	0.5	10	10	0.3	0.5	**0.9502**	0.9432	0.9401	**0.9498**	**0.9970**	***0.0138***	0.0313	0.0695	***0.0138***	0.0821
30	30	0.5	0.5	10	10	0.5	0.5	**0.9518**	0.9442	0.9364	**0.9514**	**0.9992**	***0.0090***	0.0216	0.0433	***0.0090***	0.0943
30	30	0.5	1	1	1	0.3	0.3	**0.9534**	0.9184	**0.9484**	**0.9534**	0.8690	***1.0779***	3.9289	5.2874	***1.0764***	3.4710
30	30	0.5	1	1	1	0.3	0.5	**0.9562**	0.9314	0.9424	**0.9554**	0.8962	0.7552	2.4676	3.8485	***0.7543***	4.4720
30	30	0.5	1	1	1	0.5	0.5	**0.9548**	0.9384	0.9355	**0.9544**	0.9044	0.4990	1.4910	2.5111	***0.4984***	4.4980
30	30	0.5	1	1	5	0.3	0.3	**0.9484**	**0.9508**	**0.9488**	**0.9482**	**0.9930**	0.2678	0.5981	1.3545	***0.2674***	0.6174
30	30	0.5	1	1	5	0.3	0.5	**0.9522**	**0.9496**	0.9399	**0.9518**	**0.9962**	0.1833	0.4074	0.9097	***0.1830***	0.7957
30	30	0.5	1	1	5	0.5	0.5	**0.9550**	**0.9536**	0.9442	**0.9548**	**0.9988**	0.1190	0.2637	0.5955	***0.1188***	0.8851
30	30	0.5	1	5	5	0.3	0.3	**0.9532**	0.9380	0.9375	**0.9530**	0.9310	0.2156	0.4312	1.0310	***0.2153***	0.4861
30	30	0.5	1	5	5	0.3	0.5	**0.9556**	0.9424	0.9401	**0.9552**	**0.9672**	0.1511	0.3126	0.7114	***0.1509***	0.7164
30	30	0.5	1	5	5	0.5	0.5	**0.9554**	**0.9524**	0.9381	**0.9552**	**0.9690**	0.0998	0.2102	0.4753	***0.0997***	0.7060
30	30	0.5	1	5	10	0.3	0.3	**0.9536**	**0.9450**	**0.9463**	**0.9532**	**0.9604**	0.1119	0.2200	0.5316	***0.1118***	0.2817
30	30	0.5	1	5	10	0.3	0.5	**0.9556**	0.9438	0.9422	**0.9552**	**0.9826**	0.0779	0.1622	0.3702	***0.0778***	0.4118
30	30	0.5	1	5	10	0.5	0.5	**0.9526**	**0.9520**	0.9357	**0.9524**	**0.9850**	0.0513	0.1110	0.2430	***0.0512***	0.4244
30	30	0.5	1	10	10	0.3	0.3	**0.9504**	0.9436	0.9396	**0.9502**	**0.9514**	0.1078	0.2135	0.5087	***0.1077***	0.2794
30	30	0.5	1	10	10	0.3	0.5	**0.9546**	0.9430	0.9359	**0.9544**	**0.9812**	0.0755	0.1582	0.3824	***0.0754***	0.4119
30	30	0.5	1	10	10	0.5	0.5	**0.9542**	**0.9526**	0.9386	**0.9540**	**0.9822**	***0.0499***	0.1085	0.2387	***0.0499***	0.4138
30	30	1	1	1	1	0.3	0.3	**0.9478**	**0.9486**	0.9424	**0.9476**	**1.0000**	1.6257	6.6087	2.9601	***1.6231***	5.4600
30	30	1	1	1	1	0.3	0.5	**0.9518**	**0.9480**	**0.9450**	**0.9518**	**0.9998**	1.1075	3.9162	5.5739	***1.1060***	6.4530
30	30	1	1	1	1	0.5	0.5	**0.9532**	**0.9472**	**0.9473**	**0.9530**	**1.0000**	0.7170	2.2669	3.4048	***0.7161***	6.9950
30	30	1	1	1	5	0.3	0.3	**0.9458**	0.9194	**0.9493**	**0.9454**	0.8848	1.1039	3.9747	5.2099	***1.1023***	3.5320
30	30	1	1	1	5	0.3	0.5	**0.9468**	0.9238	0.9352	**0.9468**	0.9096	0.7676	2.4451	3.6789	***0.7666***	3.6680
30	30	1	1	1	5	0.5	0.5	**0.9536**	**0.9468**	**0.9486**	**0.9532**	0.9374	0.5061	1.5002	2.4653	***0.5055***	4.5900
30	30	1	1	5	5	0.3	0.3	**0.9476**	**0.9544**	**0.9456**	**0.9474**	**0.9990**	0.3250	0.6527	1.6359	***0.3245***	0.7047
30	30	1	1	5	5	0.3	0.5	**0.9502**	**0.9466**	0.9402	**0.9500**	**1.0000**	0.2216	0.4569	1.1113	***0.2213***	0.8939
30	30	1	1	5	5	0.5	0.5	**0.9522**	**0.9498**	**0.9486**	**0.9522**	**1.0000**	0.1434	0.3020	0.6823	***0.1432***	1.0450
30	30	1	1	5	10	0.3	0.3	**0.9460**	**0.9466**	0.9398	**0.9458**	**0.9862**	0.2513	0.5009	1.1851	***0.2509***	0.5676
30	30	1	1	5	10	0.3	0.5	**0.9520**	0.9416	0.9446	**0.9518**	**0.9960**	0.1724	0.3542	0.8246	***0.1722***	0.6495
30	30	1	1	5	10	0.5	0.5	**0.9566**	**0.9458**	**0.9470**	**0.9564**	**0.9972**	0.1123	0.2377	0.5668	***0.1122***	0.8377
30	30	1	1	10	10	0.3	0.3	**0.9466**	**0.9500**	0.9382	**0.9460**	**0.9942**	0.1625	0.3134	0.7993	***0.1622***	0.3933
30	30	1	1	10	10	0.3	0.5	**0.9514**	0.9432	**0.9493**	**0.9512**	**0.9982**	0.1108	0.2269	0.5566	***0.1106***	0.5021
30	30	1	1	10	10	0.5	0.5	**0.9514**	**0.9470**	**0.9498**	**0.9512**	**0.9996**	0.0717	0.1539	0.3375	***0.0716***	0.5974

Note: Bold values of CP mean a value close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 2. The coverage probabilities and average widths of the 95% confidence intervals for the difference in variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (50, 50).

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
50	50	0.5	0.5	1	1	0.3	0.3	**0.9488**	**0.9520**	**0.9493**	**0.9486**	**1.0000**	0.0607	0.1445	0.3050	***0.0606***	0.3735
50	50	0.5	0.5	1	1	0.3	0.5	**0.9524**	**0.9498**	0.9382	**0.9520**	**1.0000**	0.1725	0.4443	0.8345	***0.1722***	0.4407
50	50	0.5	0.5	1	1	0.5	0.5	**0.9468**	**0.9490**	**0.9471**	**0.9464**	**1.0000**	0.1162	0.2873	0.5657	***0.1160***	0.5022
50	50	0.5	0.5	1	5	0.3	0.3	**0.9500**	**0.9496**	0.9449	**0.9498**	0.9360	0.0433	0.1017	0.2162	***0.0432***	0.2580
50	50	0.5	0.5	1	5	0.3	0.5	**0.9482**	0.9330	0.9422	**0.9480**	**0.9582**	0.1355	0.3361	0.6603	***0.1353***	0.2653
50	50	0.5	0.5	1	5	0.5	0.5	**0.9514**	0.9370	0.9387	**0.9514**	**0.9764**	0.0951	0.2301	0.4813	***0.0950***	0.3474
50	50	0.5	0.5	5	5	0.3	0.3	**0.9500**	**0.9472**	0.9420	**0.9496**	**0.9946**	***0.0121***	0.0266	0.0575	***0.0121***	0.0758
50	50	0.5	0.5	5	5	0.3	0.5	**0.9508**	0.9440	0.9385	**0.9506**	**0.9992**	***0.0345***	0.0682	0.1712	***0.0345***	0.0963
50	50	0.5	0.5	5	5	0.5	0.5	**0.9478**	**0.9468**	0.9380	**0.9476**	**1.0000**	***0.0232***	0.0484	0.1144	***0.0232***	0.1142
50	50	0.5	0.5	5	10	0.3	0.3	**0.9472**	**0.9498**	0.9381	**0.9470**	**0.9846**	***0.0095***	0.0216	0.0483	***0.0095***	0.0649
50	50	0.5	0.5	5	10	0.3	0.5	**0.9530**	0.9430	**0.9495**	**0.9530**	**0.9976**	***0.0291***	0.0583	0.1420	***0.0291***	0.0740
50	50	0.5	0.5	5	10	0.5	0.5	**0.9528**	**0.9468**	0.9363	**0.9524**	**0.9986**	0.0201	0.0424	0.0955	***0.0200***	0.0954
50	50	0.5	0.5	10	10	0.3	0.3	**0.9502**	0.9446	0.9407	**0.9502**	**0.9852**	***0.0061***	0.0151	0.0299	***0.0061***	0.0523
50	50	0.5	0.5	10	10	0.3	0.5	**0.9510**	0.9436	0.9385	**0.9508**	**0.9968**	***0.0172***	0.0372	0.0812	***0.0172***	0.0630
50	50	0.5	0.5	10	10	0.5	0.5	**0.9468**	**0.9498**	0.9368	**0.9468**	**0.9998**	***0.0116***	0.0269	0.0588	***0.0116***	0.0722
50	50	0.5	1	1	1	0.3	0.3	**0.9516**	**0.9486**	**0.9484**	**0.9512**	0.8982	0.3415	0.9692	1.6811	***0.3411***	2.5060
50	50	0.5	1	1	1	0.3	0.5	**0.9480**	0.9246	0.9374	**0.9478**	0.9328	0.7675	2.5050	3.7803	***0.7665***	3.2520

Table 2. *Cont.*

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
50	50	0.5	1	1	1	0.5	0.5	**0.9510**	0.9378	0.9425	**0.9508**	0.9356	0.5051	1.4968	2.5595	***0.5045***	3.2320
50	50	0.5	1	1	5	0.3	0.3	**0.9490**	**0.9520**	0.9439	**0.9488**	**0.9934**	0.0807	0.1778	0.3853	***0.0806***	0.4595
50	50	0.5	1	1	5	0.3	0.5	**0.9504**	**0.9460**	**0.9479**	**0.9500**	**0.9970**	0.2130	0.4962	1.0702	***0.2127***	0.6143
50	50	0.5	1	1	5	0.5	0.5	**0.9462**	**0.9522**	0.9438	**0.9460**	**0.9990**	0.1414	0.3260	0.6760	***0.1412***	0.6628
50	50	0.5	1	5	5	0.3	0.3	**0.9530**	**0.9476**	**0.9490**	**0.9530**	0.9414	0.0683	0.1450	0.3324	***0.0682***	0.3747
50	50	0.5	1	5	5	0.3	0.5	**0.9476**	0.9390	0.9391	**0.9474**	**0.9814**	0.1534	0.3162	0.7423	***0.1532***	0.5485
50	50	0.5	1	5	5	0.5	0.5	**0.9500**	0.9434	0.9375	**0.9498**	**0.9798**	0.1010	0.2121	0.4958	***0.1009***	0.5472
50	50	0.5	1	5	10	0.3	0.3	**0.9522**	**0.9492**	0.9381	**0.9516**	**0.9686**	***0.0350***	0.0771	0.1717	***0.0350***	0.2175
50	50	0.5	1	5	10	0.3	0.5	**0.9490**	0.9380	0.9389	**0.9488**	**0.9902**	0.0816	0.1679	0.3994	***0.0815***	0.3195
50	50	0.5	1	5	10	0.5	0.5	**0.9500**	**0.9478**	0.9407	**0.9498**	**0.9924**	***0.0536***	0.1149	0.2560	***0.0536***	0.3264
50	50	0.5	1	10	10	0.3	0.3	**0.9542**	**0.9488**	**0.9484**	**0.9542**	**0.9620**	***0.0341***	0.0755	0.1616	***0.0341***	0.2151
50	50	0.5	1	10	10	0.3	0.5	**0.9474**	0.9372	**0.9462**	**0.9472**	**0.9874**	0.0767	0.1601	0.3846	***0.0766***	0.3187
50	50	0.5	1	10	10	0.5	0.5	**0.9504**	**0.9452**	**0.9476**	**0.9502**	**0.9906**	0.0505	0.1094	0.2425	***0.0504***	0.3214
50	50	1	1	1	1	0.3	0.3	**0.9480**	**0.9484**	0.9380	**0.9476**	**1.0000**	0.4852	1.4275	2.4407	***0.4847***	3.8540
50	50	1	1	1	1	0.3	0.5	**0.9498**	**0.9480**	**0.9480**	**0.9494**	**1.0000**	1.3794	5.2961	6.5355	***1.3773***	4.3640
50	50	1	1	1	1	0.5	0.5	**0.9476**	**0.9492**	0.9432	**0.9468**	**1.0000**	0.9293	3.1140	4.5143	***0.9281***	5.0360
50	50	1	1	1	5	0.3	0.3	**0.9490**	0.9430	**0.9493**	**0.9488**	0.9110	0.3461	0.9804	1.6284	***0.3457***	2.5640
50	50	1	1	1	5	0.3	0.5	**0.9472**	0.9170	**0.9489**	**0.9472**	0.9260	1.0829	3.9188	5.1871	***1.0813***	2.6260
50	50	1	1	1	5	0.5	0.5	**0.9478**	0.9290	**0.9485**	**0.9472**	**0.9522**	0.7607	2.4482	3.7343	***0.7597***	3.2860
50	50	1	1	5	5	0.3	0.3	**0.9488**	**0.9496**	0.9396	**0.9486**	**0.9986**	0.0971	0.2059	0.4649	***0.0969***	0.5395
50	50	1	1	5	5	0.3	0.5	**0.9508**	**0.9450**	**0.9463**	**0.9506**	**0.9992**	0.2760	0.5592	1.3668	***0.2756***	0.6754
50	50	1	1	5	5	0.5	0.5	**0.9476**	**0.9506**	0.9397	**0.9472**	**1.0000**	0.1858	0.3851	0.8948	***0.1856***	0.7951
50	50	1	1	5	10	0.3	0.3	**0.9472**	**0.9556**	**0.9471**	**0.9468**	**0.9854**	0.0764	0.1633	0.3653	***0.0763***	0.4310
50	50	1	1	5	10	0.3	0.5	**0.9522**	0.9444	0.9362	**0.9522**	**0.9950**	0.2329	0.4680	1.1580	***0.2325***	0.4954
50	50	1	1	5	10	0.5	0.5	**0.9516**	**0.9484**	**0.9494**	**0.9516**	**0.9978**	0.1606	0.3323	0.7975	***0.1604***	0.6403
50	50	1	1	10	10	0.3	0.3	**0.9500**	**0.9472**	0.9433	**0.9496**	**0.9940**	***0.0485***	0.1065	0.2352	***0.0485***	0.3022
50	50	1	1	10	10	0.3	0.5	**0.9508**	0.9440	**0.9482**	**0.9506**	**0.9982**	0.1381	0.2728	0.6947	***0.1379***	0.3842
50	50	1	1	10	10	0.5	0.5	**0.9478**	**0.9468**	0.9385	**0.9476**	**1.0000**	0.0929	0.1935	0.4653	***0.0928***	0.4548

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 3. The coverage probabilities and average widths of the 95% confidence intervals for the difference in variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (100, 100).

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
100	100	0.5	0.5	1	1	0.3	0.3	**0.9492**	**0.9456**	0.9375	**0.9490**	**0.9996**	0.0762	0.1828	0.3867	***0.0761***	0.2532
100	100	0.5	0.5	1	1	0.3	0.5	**0.9490**	**0.9484**	**0.9474**	**0.9488**	**0.9998**	0.2002	0.5795	0.9779	***0.1999***	0.3019
100	100	0.5	0.5	1	1	0.5	0.5	**0.9474**	0.9424	0.9427	**0.9470**	**1.0000**	0.1323	0.3561	0.6245	***0.1321***	0.3403
100	100	0.5	0.5	1	5	0.3	0.3	**0.9518**	0.9370	**0.9451**	**0.9516**	**0.9608**	0.0625	0.1480	0.3116	***0.0624***	0.1798
100	100	0.5	0.5	1	5	0.3	0.5	**0.9462**	0.9342	**0.9480**	**0.9458**	**0.9650**	0.1375	0.3493	0.6702	***0.1373***	0.1853
100	100	0.5	0.5	1	5	0.5	0.5	**0.9522**	0.9366	**0.9496**	**0.9522**	**0.9874**	0.0954	0.2336	0.4793	***0.0952***	0.2399
100	100	0.5	0.5	5	5	0.3	0.3	**0.9504**	**0.9484**	0.9391	**0.9500**	**0.9910**	***0.0152***	0.0330	0.0732	***0.0152***	0.0529
100	100	0.5	0.5	5	5	0.3	0.5	**0.9472**	0.9414	0.9399	**0.9472**	**0.9984**	***0.0400***	0.0855	0.2032	***0.0400***	0.0677
100	100	0.5	0.5	5	5	0.5	0.5	**0.9450**	0.9396	0.9443	0.9448	**0.9998**	***0.0265***	0.0611	0.1293	0.0264	0.0799
100	100	0.5	0.5	5	10	0.3	0.3	**0.9502**	**0.9468**	0.9446	**0.9498**	**0.9848**	***0.0132***	0.0290	0.0656	***0.0132***	0.0452
100	100	0.5	0.5	5	10	0.3	0.5	**0.9488**	**0.9452**	0.9416	**0.9486**	**0.9980**	***0.0312***	0.0663	0.1529	***0.0312***	0.0517
100	100	0.5	0.5	5	10	0.5	0.5	**0.9488**	0.9434	0.9394	**0.9486**	**0.9994**	***0.0211***	0.0482	0.1040	***0.0211***	0.0667
100	100	0.5	0.5	10	10	0.3	0.3	**0.9504**	**0.9520**	**0.9467**	**0.9502**	**0.9854**	***0.0076***	0.0186	0.0367	***0.0076***	0.0365
100	100	0.5	0.5	10	10	0.3	0.5	**0.9470**	0.9386	0.9427	**0.9468**	**0.9984**	***0.0200***	0.0474	0.0965	***0.0200***	0.0439
100	100	0.5	0.5	10	10	0.5	0.5	**0.9468**	0.9420	0.9430	**0.9466**	**0.9998**	***0.0132***	0.0350	0.0625	***0.0132***	0.0506
100	100	0.5	1	1	1	0.3	0.3	**0.9482**	0.9380	0.9445	**0.9480**	0.9302	0.3447	0.9702	1.7077	***0.3443***	1.6950
100	100	0.5	1	1	1	0.3	0.5	**0.9500**	0.9084	0.9428	**0.9496**	**0.9622**	1.0250	5.3466	5.0533	***1.0233***	2.1550
100	100	0.5	1	1	1	0.5	0.5	**0.9500**	0.9170	0.9363	**0.9494**	**0.9678**	0.6786	2.4892	3.2223	***0.6776***	2.1560
100	100	0.5	1	1	5	0.3	0.3	**0.9514**	**0.9496**	**0.9459**	**0.9512**	**0.9930**	0.0934	0.2115	0.4418	***0.0933***	0.3161
100	100	0.5	1	1	5	0.3	0.5	**0.9468**	0.9384	**0.9479**	**0.9466**	**0.9962**	0.2615	0.6466	1.3169	***0.2611***	0.4293
100	100	0.5	1	1	5	0.5	0.5	**0.9460**	0.9374	0.9449	**0.9458**	**0.9996**	0.1716	0.4279	0.8249	***0.1713***	0.4564
100	100	0.5	1	5	5	0.3	0.3	**0.9482**	**0.9480**	0.9420	**0.9480**	**0.9662**	0.0689	0.1463	0.3293	***0.0689***	0.2618
100	100	0.5	1	5	5	0.3	0.5	**0.9496**	0.9298	**0.9450**	**0.9496**	**0.9900**	0.2049	0.4829	1.0340	***0.2045***	0.3855
100	100	0.5	1	5	5	0.5	0.5	**0.9512**	0.9294	0.9352	**0.9508**	**0.9920**	0.1356	0.3354	0.6857	***0.1354***	0.3866
100	100	0.5	1	5	10	0.3	0.3	**0.9504**	**0.9508**	0.9352	**0.9502**	**0.9750**	0.0363	0.0797	0.1740	***0.0362***	0.1535
100	100	0.5	1	5	10	0.3	0.5	**0.9464**	0.9290	**0.9481**	**0.9462**	**0.9940**	0.1072	0.2546	0.5319	***0.1070***	0.2255
100	100	0.5	1	5	10	0.5	0.5	**0.9484**	0.9308	0.9382	**0.9482**	**0.9958**	0.0707	0.1843	0.3452	***0.0706***	0.2317
100	100	0.5	1	10	10	0.3	0.3	**0.9468**	**0.9482**	**0.9463**	**0.9468**	**0.9768**	0.0345	0.0763	0.1698	***0.0344***	0.1507
100	100	0.5	1	10	10	0.3	0.5	**0.9486**	0.9274	0.9396	**0.9478**	**0.9962**	0.1024	0.2486	0.5052	***0.1022***	0.2262
100	100	0.5	1	10	10	0.5	0.5	**0.9508**	0.9302	**0.9459**	**0.9506**	**0.9938**	0.0678	0.1806	0.3371	***0.0677***	0.2250
100	100	1	1	1	1	0.3	0.3	**0.9486**	**0.9482**	**0.9469**	**0.9482**	**1.0000**	0.6097	1.8484	3.0446	***0.6089***	2.5200
100	100	1	1	1	1	0.3	0.5	**0.9480**	**0.9500**	0.9407	**0.9480**	**1.0000**	1.6018	8.1861	7.9901	***1.5991***	2.8340
100	100	1	1	1	1	0.5	0.5	**0.9452**	**0.9486**	0.9448	**0.9450**	**1.0000**	1.0586	4.0019	5.1331	***1.0571***	3.1690
100	100	1	1	1	5	0.3	0.3	**0.9512**	0.9350	0.9438	**0.9508**	**0.9454**	0.5001	1.4748	2.5065	***0.4995***	1.7180
100	100	1	1	1	5	0.3	0.5	**0.9472**	0.9216	**0.9480**	**0.9470**	**0.9460**	1.1003	4.1301	5.5312	***1.0987***	1.7430
100	100	1	1	1	5	0.5	0.5	**0.9506**	0.9268	0.9410	**0.9506**	**0.9706**	0.7627	2.4725	3.6037	***0.7617***	2.1680

Table 3. *Cont.*

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
100	100	1	1	5	5	0.3	0.3	**0.9496**	**0.9502**	**0.9468**	**0.9494**	**0.9976**	0.1219	0.2570	0.6123	***0.1218***	0.3706
100	100	1	1	5	5	0.3	0.5	**0.9468**	0.9444	0.9414	**0.9466**	**0.9988**	0.3205	0.6992	1.6277	***0.3200***	0.4706
100	100	1	1	5	5	0.5	0.5	**0.9450**	0.9420	0.9357	0.9446	**1.0000**	***0.2118***	0.4766	1.0108	0.2114	0.5525
100	100	1	1	5	10	0.3	0.3	**0.9498**	**0.9462**	0.9396	**0.9492**	**0.9862**	0.1054	0.2226	0.5103	***0.1053***	0.3017
100	100	1	1	5	10	0.3	0.5	**0.9484**	**0.9472**	0.9418	**0.9480**	**0.9954**	0.2499	0.5242	1.2100	***0.2495***	0.3472
100	100	1	1	5	10	0.5	0.5	**0.9494**	**0.9438**	**0.9496**	**0.9492**	**0.9982**	0.1689	0.3677	0.7986	***0.1686***	0.4488
100	100	1	1	10	10	0.3	0.3	**0.9504**	**0.9484**	0.9384	**0.9500**	**0.9902**	0.0610	0.1319	0.2867	***0.0609***	0.2114
100	100	1	1	10	10	0.3	0.5	**0.9472**	**0.9414**	0.9379	**0.9472**	**0.9984**	0.1602	0.3421	0.8077	***0.1599***	0.2692
100	100	1	1	10	10	0.5	0.5	**0.9450**	**0.9396**	0.9414	0.9448	**0.9996**	***0.1059***	0.2445	0.5195	0.1057	0.3187

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 4. The coverage probabilities and average widths of the 95% confidence intervals for the difference in variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (200, 200).

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
200	200	0.5	0.5	1	1	0.3	0.3	**0.9466**	**0.9504**	**0.9461**	**0.9466**	**0.9956**	0.0842	0.2183	0.4105	***0.0841***	0.1757
200	200	0.5	0.5	1	1	0.3	0.5	**0.9466**	**0.9508**	0.9374	**0.9466**	**0.9988**	***0.0566***	0.1443	0.2783	***0.0566***	0.2063
200	200	0.5	0.5	1	1	0.5	0.5	**0.9534**	0.9448	0.9371	**0.9534**	**1.0000**	0.1670	0.4538	0.7901	***0.1667***	0.2337
200	200	0.5	0.5	1	5	0.3	0.3	**0.9484**	**0.9462**	0.9418	**0.9484**	**0.9694**	0.0629	0.1503	0.2987	***0.0628***	0.1255
200	200	0.5	0.5	1	5	0.3	0.5	0.9440	**0.9502**	0.9416	0.9436	**0.9774**	0.0431	***0.1023***	0.2160	0.0430	0.1297
200	200	0.5	0.5	1	5	0.5	0.5	**0.9492**	0.9334	**0.9456**	**0.9486**	**0.9910**	0.1340	0.3346	0.6610	***0.1338***	0.1678
200	200	0.5	0.5	5	5	0.3	0.3	**0.9456**	**0.9496**	**0.9495**	**0.9456**	**0.9888**	***0.0168***	0.0414	0.0794	***0.0168***	0.0371
200	200	0.5	0.5	5	5	0.3	0.5	**0.9492**	**0.9556**	0.9427	**0.9486**	**0.9980**	***0.0113***	0.0288	0.0562	***0.0113***	0.0476
200	200	0.5	0.5	5	5	0.5	0.5	**0.9534**	**0.9490**	0.9408	**0.9532**	**0.9998**	0.0334	0.0723	0.1607	***0.0333***	0.0563
200	200	0.5	0.5	5	10	0.3	0.3	**0.9470**	**0.9510**	0.9391	**0.9466**	**0.9868**	***0.0137***	0.0329	0.0648	***0.0137***	0.0319
200	200	0.5	0.5	5	10	0.3	0.5	**0.9492**	**0.9530**	0.9372	**0.9488**	**0.9962**	***0.0093***	0.0230	0.0472	***0.0093***	0.0363
200	200	0.5	0.5	5	10	0.5	0.5	**0.9542**	**0.9462**	0.9449	**0.9542**	**0.9994**	***0.0285***	0.0605	0.1395	***0.0285***	0.0469
200	200	0.5	0.5	10	10	0.3	0.3	**0.9456**	**0.9478**	0.9380	**0.9452**	**0.9812**	***0.0084***	0.0242	0.0414	***0.0084***	0.0257
200	200	0.5	0.5	10	10	0.3	0.5	**0.9494**	**0.9504**	**0.9479**	**0.9492**	**0.9980**	***0.0057***	0.0170	0.0267	***0.0057***	0.0311
200	200	0.5	0.5	10	10	0.5	0.5	**0.9528**	**0.9460**	**0.9479**	**0.9528**	**0.9998**	***0.0167***	0.0405	0.0848	***0.0167***	0.0354
200	200	0.5	1	1	1	0.3	0.3	**0.9478**	0.9332	**0.9499**	**0.9470**	**0.9548**	0.4340	1.4403	2.1197	***0.4335***	1.1750
200	200	0.5	1	1	1	0.3	0.5	**0.9474**	0.9446	0.9406	**0.9472**	**0.9806**	0.2936	0.9285	1.3932	***0.2933***	1.4680
200	200	0.5	1	1	1	0.5	0.5	**0.9504**	0.9254	**0.9477**	**0.9502**	**0.9762**	0.7000	2.6513	3.3815	***0.6990***	1.4590
200	200	0.5	1	1	5	0.3	0.3	**0.9484**	0.9444	**0.9463**	**0.9478**	**0.9910**	0.1086	0.2758	0.5505	***0.1085***	0.2229
200	200	0.5	1	1	5	0.3	0.5	**0.9488**	**0.9482**	0.9359	**0.9484**	**0.9968**	0.0729	0.1869	0.3433	***0.0728***	0.2996
200	200	0.5	1	1	5	0.5	0.5	**0.9502**	**0.9480**	**0.9462**	**0.9500**	**0.9996**	0.2033	0.5184	0.9649	***0.2030***	0.3169
200	200	0.5	1	5	5	0.3	0.3	**0.9480**	0.9366	0.9365	**0.9478**	**0.9750**	0.0868	0.2253	0.4131	***0.0867***	0.1850
200	200	0.5	1	5	5	0.3	0.5	**0.9498**	0.9442	0.9427	**0.9496**	**0.9938**	***0.0587***	0.1558	0.2794	***0.0587***	0.2732
200	200	0.5	1	5	5	0.5	0.5	**0.9522**	0.9402	0.9402	**0.9518**	**0.9960**	0.1399	0.3458	0.6810	***0.1397***	0.2740
200	200	0.5	1	5	10	0.3	0.3	**0.9470**	0.9432	0.9391	**0.9470**	**0.9786**	0.0450	0.1264	0.2222	***0.0449***	0.1076
200	200	0.5	1	5	10	0.3	0.5	**0.9468**	**0.9462**	0.9447	**0.9466**	**0.9976**	0.0304	0.0883	0.1458	***0.0303***	0.1602
200	200	0.5	1	5	10	0.5	0.5	**0.9534**	0.9412	0.9371	**0.9530**	**0.9974**	0.0754	0.1917	0.3812	***0.0753***	0.1635
200	200	0.5	1	10	10	0.3	0.3	**0.9472**	0.9434	0.9365	**0.9466**	**0.9804**	***0.0434***	0.1242	0.2195	***0.0434***	0.1058
200	200	0.5	1	10	10	0.3	0.5	**0.9498**	**0.9450**	**0.9496**	**0.9494**	**0.9970**	0.0294	0.0869	0.1406	***0.0293***	0.1591
200	200	0.5	1	10	10	0.5	0.5	**0.9522**	0.9384	**0.9463**	**0.9522**	**0.9994**	0.0699	0.1848	0.3408	***0.0698***	0.1600
200	200	1	1	1	1	0.3	0.3	**0.9470**	**0.9506**	0.9376	**0.9468**	**0.9992**	0.6735	2.2374	3.1868	***0.6727***	1.7040
200	200	1	1	1	1	0.3	0.5	**0.9488**	**0.9514**	0.9395	**0.9486**	**1.0000**	0.4530	1.4049	2.1869	***0.4524***	1.9210
200	200	1	1	1	1	0.5	0.5	**0.9532**	0.9408	**0.9486**	**0.9526**	**1.0000**	1.3370	5.3507	6.4529	***1.3349***	2.1010
200	200	1	1	1	5	0.3	0.3	**0.9472**	0.9382	0.9351	**0.9470**	**0.9612**	0.5030	1.4895	2.4307	***0.5024***	1.1970
200	200	1	1	1	5	0.3	0.5	0.9446	**0.9464**	**0.9493**	0.9440	**0.9650**	0.3444	***0.9824***	1.6713	0.3440	1.2040
200	200	1	1	1	5	0.5	0.5	**0.9482**	0.9234	0.9396	**0.9482**	**0.9880**	1.0732	3.7995	5.2432	***1.0716***	1.4820
200	200	1	1	5	5	0.3	0.3	**0.9466**	**0.9472**	0.9416	**0.9462**	**0.9926**	0.1347	0.3132	0.6654	***0.1345***	0.2614
200	200	1	1	5	5	0.3	0.5	**0.9468**	**0.9556**	0.9359	**0.9466**	**0.9986**	0.0906	0.2143	0.4464	***0.0905***	0.3293
200	200	1	1	5	5	0.5	0.5	**0.9538**	**0.9518**	0.9363	**0.9536**	**0.9998**	0.2671	0.5785	1.3194	***0.2667***	0.3863
200	200	1	1	5	10	0.3	0.3	**0.9472**	**0.9496**	0.9420	**0.9466**	**0.9874**	0.1094	0.2453	0.5177	***0.1093***	0.2121
200	200	1	1	5	10	0.3	0.5	**0.9490**	**0.9524**	0.9394	**0.9488**	**0.9976**	0.0743	0.1694	0.3635	***0.0742***	0.2442
200	200	1	1	5	10	0.5	0.5	**0.9536**	**0.9472**	0.9356	**0.9536**	**0.9990**	0.2284	0.4768	1.1544	***0.2281***	0.3143
200	200	1	1	10	10	0.3	0.3	**0.9456**	**0.9496**	**0.9450**	**0.9456**	**0.9912**	0.0674	0.1655	0.3174	***0.0673***	0.1483
200	200	1	1	10	10	0.3	0.5	**0.9492**	**0.9556**	**0.9482**	**0.9486**	**0.9972**	0.0453	0.1150	0.2200	***0.0452***	0.1903
200	200	1	1	10	10	0.5	0.5	**0.9534**	**0.9490**	**0.9470**	**0.9532**	**0.9998**	0.1334	0.2891	0.6383	***0.1332***	0.2256

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 5. The coverage probabilities and average widths of the 95% confidence intervals for the difference in variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (30, 50).

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
30	50	0.5	0.5	1	1	0.3	0.3	**0.9530**	**0.9476**	0.9434	**0.9526**	**0.9998**	0.1116	0.2879	0.5261	***0.1114***	0.4418
30	50	0.5	0.5	1	1	0.3	0.5	**0.9524**	**0.9520**	**0.9471**	**0.9520**	**1.0000**	0.0728	0.1838	0.3646	***0.0727***	0.5057
30	50	0.5	0.5	1	1	0.5	0.5	**0.9526**	0.9388	**0.9462**	**0.9526**	**1.0000**	0.1986	0.5991	1.0105	***0.1983***	0.6038
30	50	0.5	0.5	1	5	0.3	0.3	**0.9526**	0.9388	**0.9491**	**0.9526**	0.9092	0.0945	0.2302	0.4684	***0.0944***	0.3322
30	50	0.5	0.5	1	5	0.3	0.5	**0.9528**	**0.9450**	0.9360	**0.9526**	0.9334	0.0622	0.1492	0.2975	***0.0621***	0.3519
30	50	0.5	0.5	1	5	0.5	0.5	**0.9504**	0.9156	0.9423	**0.9500**	**0.9480**	0.1316	0.3720	0.6327	***0.1314***	0.4604
30	50	0.5	0.5	5	5	0.3	0.3	**0.9522**	**0.9472**	0.9388	**0.9522**	**0.9906**	0.0223	0.0509	0.1054	***0.0223***	0.0874
30	50	0.5	0.5	5	5	0.3	0.5	**0.9526**	**0.9478**	0.9430	**0.9526**	**0.9988**	0.0146	0.0348	0.0696	***0.0145***	0.1071
30	50	0.5	0.5	5	5	0.5	0.5	**0.9520**	0.9332	0.9397	**0.9518**	**0.9990**	0.0397	0.0920	0.2004	***0.0396***	0.1328
30	50	0.5	0.5	5	10	0.3	0.3	**0.9528**	0.9436	0.9426	**0.9526**	**0.9784**	***0.0197***	0.0439	0.0961	***0.0197***	0.0785
30	50	0.5	0.5	5	10	0.3	0.5	**0.9526**	**0.9520**	**0.9462**	**0.9524**	**0.9898**	***0.0129***	0.0300	0.0629	***0.0129***	0.0865
30	50	0.5	0.5	5	10	0.5	0.5	**0.9538**	0.9324	**0.9470**	**0.9538**	**0.9958**	0.0305	0.0736	0.1476	***0.0304***	0.1164
30	50	0.5	0.5	10	10	0.3	0.3	**0.9518**	**0.9458**	0.9423	**0.9514**	**0.9830**	0.0112	0.0291	0.0554	***0.0111***	0.0607
30	50	0.5	0.5	10	10	0.3	0.5	**0.9522**	**0.9534**	0.9378	**0.9522**	**0.9920**	***0.0073***	0.0202	0.0362	***0.0073***	0.0705
30	50	0.5	0.5	10	10	0.5	0.5	**0.9510**	0.9334	0.9418	**0.9506**	**0.9996**	0.0199	0.0519	0.0998	***0.0198***	0.0843
30	50	0.5	1	1	1	0.3	0.3	**0.9540**	0.9380	0.9377	**0.9540**	0.9014	0.4440	1.4640	2.1364	***0.4434***	2.5740
30	50	0.5	1	1	1	0.3	0.5	**0.9522**	**0.9452**	**0.9490**	**0.9518**	0.9274	0.2977	0.9381	1.4985	***0.2973***	3.1660
30	50	0.5	1	1	1	0.5	0.5	**0.9568**	0.9066	0.9437	**0.9560**	**0.9450**	1.0323	4.6303	5.0934	***1.0306***	3.2760
30	50	0.5	1	1	5	0.3	0.3	**0.9522**	**0.9498**	**0.9468**	**0.9520**	**0.9996**	0.1326	0.3379	0.6651	***0.1324***	0.5244
30	50	0.5	1	1	5	0.3	0.5	**0.9532**	**0.9462**	0.9387	**0.9530**	**0.9990**	0.0866	0.2203	0.4366	***0.0865***	0.6674
30	50	0.5	1	1	5	0.5	0.5	**0.9512**	0.9378	0.9415	**0.9504**	**0.9994**	0.2613	0.6713	1.2680	***0.2609***	0.7475
30	50	0.5	1	5	5	0.3	0.3	**0.9534**	**0.9468**	0.9388	**0.9532**	**0.9538**	0.0888	0.2284	0.4328	***0.0887***	0.3761
30	50	0.5	1	5	5	0.3	0.5	**0.9504**	**0.9464**	0.9440	**0.9498**	**0.9836**	***0.0595***	0.1573	0.2802	***0.0595***	0.5497
30	50	0.5	1	5	5	0.5	0.5	**0.9532**	0.9312	**0.9482**	**0.9528**	**0.9860**	0.2065	0.4836	1.0165	***0.2062***	0.5543
30	50	0.5	1	5	10	0.3	0.3	**0.9546**	**0.9454**	0.9417	**0.9542**	**0.9728**	0.0480	0.1307	0.2319	***0.0479***	0.2224
30	50	0.5	1	5	10	0.3	0.5	**0.9528**	**0.9514**	**0.9477**	**0.9526**	**0.9918**	0.0319	0.0907	0.1569	***0.0318***	0.3274
30	50	0.5	1	5	10	0.5	0.5	**0.9552**	0.9270	**0.9463**	**0.9550**	**0.9944**	0.1078	0.2577	0.5142	***0.1076***	0.3354
30	50	0.5	1	10	10	0.3	0.3	**0.9548**	**0.9462**	**0.9471**	**0.9546**	**0.9670**	0.0444	0.1259	0.2168	***0.0443***	0.2160
30	50	0.5	1	10	10	0.3	0.5	**0.9504**	**0.9518**	**0.9485**	**0.9500**	**0.9884**	0.0298	0.0877	0.1437	***0.0297***	0.3189
30	50	0.5	1	10	10	0.5	0.5	**0.9536**	0.9262	0.9389	**0.9536**	**0.9906**	0.1031	0.2499	0.4891	***0.1029***	0.3237
30	50	1	1	1	1	0.3	0.3	**0.9522**	**0.9452**	0.9416	**0.9516**	**1.0000**	0.8925	3.1078	4.5070	***0.8913***	4.6100
30	50	1	1	1	1	0.3	0.5	**0.9512**	0.9434	0.9373	**0.9508**	**1.0000**	0.5821	1.8442	2.9230	***0.5814***	5.1840
30	50	1	1	1	1	0.5	0.5	**0.9550**	0.9422	0.9355	**0.9548**	**1.0000**	1.5870	7.8564	7.8876	***1.5841***	6.1900
30	50	1	1	1	5	0.3	0.3	**0.9516**	0.9312	0.9445	**0.9514**	0.8782	0.7558	2.4463	3.6390	***0.7549***	3.4810
30	50	1	1	1	5	0.3	0.5	**0.9530**	0.9400	0.9373	**0.9530**	0.8942	0.4975	1.4863	2.5295	***0.4969***	3.5180
30	50	1	1	1	5	0.5	0.5	**0.9534**	0.9016	0.9425	**0.9532**	0.9086	1.0521	4.4773	5.1289	***1.0504***	4.4100
30	50	1	1	5	5	0.3	0.3	**0.9526**	**0.9482**	0.9442	**0.9524**	**0.9970**	0.1785	0.3951	0.8609	***0.1783***	0.6262
30	50	1	1	5	5	0.3	0.5	**0.9542**	**0.9498**	0.9360	**0.9538**	**0.9994**	0.1165	0.2642	0.5724	***0.1163***	0.7442
30	50	1	1	5	5	0.5	0.5	**0.9508**	0.9364	**0.9452**	**0.9506**	**0.9998**	0.3177	0.7366	1.6044	***0.3171***	0.9280
30	50	1	1	5	10	0.3	0.3	**0.9520**	0.9436	0.9437	**0.9514**	**0.9716**	0.1579	0.3384	0.7779	***0.1577***	0.5345
30	50	1	1	5	10	0.3	0.5	**0.9512**	**0.9504**	**0.9480**	**0.9512**	**0.9908**	0.1036	0.2274	0.5217	***0.1034***	0.5906
30	50	1	1	5	10	0.5	0.5	**0.9530**	0.9312	**0.9477**	**0.9528**	**0.9936**	0.2437	0.5658	1.2228	***0.2433***	0.7990
30	50	1	1	10	10	0.3	0.3	**0.9522**	**0.9472**	0.9373	**0.9522**	**0.9896**	0.0892	0.2037	0.4333	***0.0891***	0.3513
30	50	1	1	10	10	0.3	0.5	**0.9526**	**0.9478**	0.9379	**0.9526**	**0.9976**	0.0583	0.1391	0.2879	***0.0582***	0.4275
30	50	1	1	10	10	0.5	0.5	**0.9520**	0.9332	0.9386	**0.9518**	**0.9994**	0.1587	0.3680	0.7949	***0.1584***	0.5312

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 6. The coverage probabilities and average widths of the 95% confidence intervals for the difference in variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (50, 100).

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
50	100	0.5	0.5	1	1	0.3	0.3	**0.9506**	**0.9490**	0.9366	**0.9504**	**0.9966**	0.1267	0.3719	0.5967	***0.1265***	0.3129
50	100	0.5	0.5	1	1	0.3	0.5	0.9438	**0.9482**	0.9388	0.9432	**0.9998**	0.0789	***0.2220***	0.3767	0.0788	0.3590
50	100	0.5	0.5	1	1	0.5	0.5	0.9448	**0.9482**	0.9399	0.9446	**1.0000**	0.0522	***0.1436***	0.2473	0.0522	0.4260
50	100	0.5	0.5	1	5	0.3	0.3	**0.9538**	0.9356	0.9410	**0.9536**	0.9244	0.0865	0.2433	0.4118	***0.0864***	0.2524
50	100	0.5	0.5	1	5	0.3	0.5	**0.9486**	0.9412	**0.9457**	**0.9476**	0.9382	0.0552	0.1528	0.2704	***0.0551***	0.2599
50	100	0.5	0.5	1	5	0.5	0.5	**0.9490**	**0.9498**	**0.9463**	**0.9486**	**0.9652**	0.0371	0.1007	0.1780	***0.0370***	0.3442
50	100	0.5	0.5	5	5	0.3	0.3	**0.9504**	0.9440	0.9406	**0.9502**	**0.9896**	***0.0253***	0.0660	0.1210	***0.0253***	0.0652
50	100	0.5	0.5	5	5	0.3	0.5	**0.9462**	0.9442	0.9351	**0.9458**	**0.9984**	0.0158	0.0445	0.0746	***0.0157***	0.0781
50	100	0.5	0.5	5	5	0.5	0.5	0.9426	**0.9478**	**0.9482**	**0.9426**	**0.9990**	0.0104	***0.0307***	0.0526	0.0104	0.0983
50	100	0.5	0.5	5	10	0.3	0.3	**0.9508**	0.9426	0.9378	**0.9506**	**0.9732**	***0.0196***	0.0537	0.0930	***0.0196***	0.0590
50	100	0.5	0.5	5	10	0.3	0.5	**0.9452**	**0.9454**	**0.9465**	0.9448	**0.9892**	***0.0123***	0.0366	0.0609	0.0123	0.0642
50	100	0.5	0.5	5	10	0.5	0.5	**0.9476**	**0.9480**	0.9364	**0.9474**	**0.9970**	***0.0082***	0.0254	0.0389	***0.0082***	0.0875
50	100	0.5	0.5	10	10	0.3	0.3	**0.9492**	0.9448	**0.9479**	**0.9486**	**0.9790**	***0.0127***	0.0387	0.0629	***0.0127***	0.0449
50	100	0.5	0.5	10	10	0.3	0.5	0.9436	**0.9472**	0.9355	0.9434	**0.9932**	0.0079	***0.0267***	0.0392	0.0079	0.0513

Table 6. *Cont.*

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
50	100	0.5	0.5	10	10	0.5	0.5	0.9444	**0.9454**	**0.9476**	0.9442	**0.9990**	0.0052	***0.0187***	0.0255	0.0052	0.0624
50	100	0.5	1	1	1	0.3	0.3	**0.9490**	0.9192	0.9366	**0.9488**	0.9410	0.6808	2.5759	3.4190	***0.6798***	1.7190
50	100	0.5	1	1	1	0.3	0.5	**0.9526**	0.9372	0.9430	**0.9524**	**0.9676**	0.4352	1.4522	2.0917	***0.4347***	2.1510
50	100	0.5	1	1	1	0.5	0.5	**0.9514**	0.9326	0.9366	**0.9512**	**0.9700**	0.2927	0.9224	1.3976	***0.2924***	2.1640
50	100	0.5	1	1	5	0.3	0.3	**0.9502**	0.9418	0.9405	**0.9502**	**0.9990**	0.1674	0.4419	0.8337	***0.1671***	0.3717
50	100	0.5	1	1	5	0.3	0.5	**0.9476**	0.9428	0.9418	**0.9468**	**0.9996**	0.1046	0.2795	0.5173	***0.1044***	0.4705
50	100	0.5	1	1	5	0.5	0.5	**0.9484**	0.9430	0.9442	**0.9482**	**0.9998**	***0.0694***	0.1864	0.3400	***0.0694***	0.5298
50	100	0.5	1	5	5	0.3	0.3	**0.9506**	0.9318	**0.9491**	**0.9506**	**0.9690**	0.1361	0.3406	0.6662	***0.1360***	0.2678
50	100	0.5	1	5	5	0.3	0.5	**0.9546**	0.9414	**0.9451**	**0.9540**	**0.9902**	0.0870	0.2272	0.4216	***0.0869***	0.3890
50	100	0.5	1	5	5	0.5	0.5	**0.9508**	0.9444	0.9425	**0.9506**	**0.9922**	0.0586	0.1562	0.2978	***0.0585***	0.3940
50	100	0.5	1	5	10	0.3	0.3	**0.9508**	0.9314	0.9405	**0.9508**	**0.9816**	0.0705	0.1878	0.3421	***0.0704***	0.1582
50	100	0.5	1	5	10	0.3	0.5	**0.9542**	0.9388	0.9422	**0.9542**	**0.9940**	0.0448	0.1280	0.2197	***0.0447***	0.2303
50	100	0.5	1	5	10	0.5	0.5	**0.9508**	0.9436	0.9431	**0.9508**	**0.9980**	***0.0300***	0.0891	0.1472	***0.0300***	0.2388
50	100	0.5	1	10	10	0.3	0.3	**0.9498**	0.9308	0.9368	**0.9488**	**0.9748**	***0.0681***	0.1832	0.3417	***0.0680***	0.1524
50	100	0.5	1	10	10	0.3	0.5	**0.9534**	0.9398	0.9380	**0.9534**	**0.9960**	***0.0435***	0.1253	0.2149	***0.0435***	0.2271
50	100	0.5	1	10	10	0.5	0.5	**0.9508**	**0.9450**	0.9362	**0.9506**	**0.9974**	***0.0293***	0.0874	0.1441	***0.0293***	0.2291
50	100	1	1	1	1	0.3	0.3	**0.9492**	**0.9474**	0.9370	**0.9488**	**1.0000**	1.0134	4.2070	4.8279	***1.0119***	3.2130
50	100	1	1	1	1	0.3	0.5	0.9432	**0.9478**	0.9396	0.9426	**1.0000**	0.6309	***2.2606***	3.0347	0.6300	3.4820
50	100	1	1	1	1	0.5	0.5	**0.9464**	**0.9492**	0.9420	**0.9460**	**1.0000**	0.4179	1.3642	2.0612	***0.4174***	4.1000
50	100	1	1	1	5	0.3	0.3	**0.9536**	0.9260	**0.9456**	**0.9532**	0.9096	0.6916	2.5744	3.3204	***0.6906***	2.5250
50	100	1	1	1	5	0.3	0.5	**0.9484**	0.9436	0.9362	**0.9484**	0.9110	0.4413	1.4837	2.1167	***0.4407***	2.5690
50	100	1	1	1	5	0.5	0.5	**0.9496**	0.9424	0.9448	**0.9494**	0.9368	0.2967	0.9235	1.4823	***0.2963***	3.2820
50	100	1	1	5	5	0.3	0.3	**0.9492**	**0.9460**	0.9396	**0.9490**	**0.9930**	0.2027	0.5032	0.9915	***0.2024***	0.4595
50	100	1	1	5	5	0.3	0.5	0.9432	**0.9512**	0.9353	0.9428	**0.9992**	0.1262	***0.3278***	0.6341	0.1260	0.5430
50	100	1	1	5	5	0.5	0.5	0.9442	**0.9498**	0.9385	0.9440	**0.9994**	0.0836	***0.2215***	0.4053	0.0835	0.6840
50	100	1	1	5	10	0.3	0.3	**0.9502**	**0.9450**	0.9441	**0.9502**	**0.9668**	0.1570	0.3955	0.7794	***0.1567***	0.4015
50	100	1	1	5	10	0.3	0.5	0.9446	**0.9486**	**0.9492**	0.9446	**0.9852**	0.0985	***0.2619***	0.4894	0.0983	0.4365
50	100	1	1	5	10	0.5	0.5	**0.9464**	**0.9488**	**0.9462**	**0.9460**	**0.9934**	***0.0656***	0.1781	0.3172	***0.0656***	0.5911
50	100	1	1	10	10	0.3	0.3	**0.9504**	0.9440	0.9355	**0.9502**	**0.9884**	0.1014	0.2641	0.5132	***0.1012***	0.2595
50	100	1	1	10	10	0.3	0.5	**0.9462**	0.9442	0.9408	**0.9458**	**0.9968**	0.0631	0.1781	0.3043	***0.0630***	0.3113
50	100	1	1	10	10	0.5	0.5	0.9426	**0.9478**	0.9409	0.9426	**0.9992**	0.0418	***0.1230***	0.1994	0.0417	0.3939

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 7. The coverage probabilities and average widths of the 95% confidence intervals for the difference in variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (100, 200).

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
100	200	0.5	0.5	1	1	0.3	0.3	**0.9524**	**0.9464**	**0.9469**	**0.9522**	**0.9920**	0.1639	0.4816	0.7854	***0.1637***	0.2174
100	200	0.5	0.5	1	1	0.3	0.5	**0.9468**	**0.9472**	**0.9465**	**0.9462**	**0.9998**	0.1037	0.2963	0.4974	***0.1035***	0.2432
100	200	0.5	0.5	1	1	0.5	0.5	**0.9506**	**0.9512**	0.9418	**0.9502**	**1.0000**	0.0663	0.1845	0.3253	***0.0662***	0.2908
100	200	0.5	0.5	1	5	0.3	0.3	**0.9552**	0.9232	0.9440	**0.9548**	**0.9560**	0.1285	0.3652	0.6115	***0.1283***	0.1759
100	200	0.5	0.5	1	5	0.3	0.5	**0.9502**	0.9388	**0.9459**	**0.9498**	**0.9590**	0.0846	0.2374	0.4238	***0.0845***	0.1799
100	200	0.5	0.5	1	5	0.5	0.5	**0.9526**	**0.9476**	0.9408	**0.9526**	**0.9802**	***0.0542***	0.1495	0.2578	***0.0542***	0.2353
100	200	0.5	0.5	5	5	0.3	0.3	**0.9502**	0.9370	0.9359	**0.9498**	**0.9852**	0.0328	0.0792	0.1639	***0.0327***	0.0456
100	200	0.5	0.5	5	5	0.3	0.5	**0.9496**	**0.9462**	0.9376	**0.9494**	**0.9974**	***0.0207***	0.0556	0.1033	***0.0207***	0.0546
100	200	0.5	0.5	5	5	0.5	0.5	**0.9506**	0.9432	0.9358	**0.9506**	**0.9988**	0.0133	0.0381	0.0640	***0.0132***	0.0690
100	200	0.5	0.5	5	10	0.3	0.3	**0.9546**	0.9300	0.9429	**0.9544**	**0.9796**	***0.0277***	0.0684	0.1368	***0.0277***	0.0412
100	200	0.5	0.5	5	10	0.3	0.5	**0.9526**	0.9424	**0.9498**	**0.9524**	**0.9912**	***0.0179***	0.0491	0.0883	***0.0179***	0.0449
100	200	0.5	0.5	5	10	0.5	0.5	**0.9518**	0.9426	**0.9500**	**0.9518**	**0.9986**	***0.0114***	0.0338	0.0565	***0.0114***	0.0616
100	200	0.5	0.5	10	10	0.3	0.3	**0.9502**	0.9336	0.9406	**0.9502**	**0.9834**	***0.0164***	0.0455	0.0780	***0.0164***	0.0316
100	200	0.5	0.5	10	10	0.3	0.5	**0.9484**	**0.9466**	0.9393	**0.9482**	**0.9946**	0.0104	0.0329	0.0496	***0.0103***	0.0360
100	200	0.5	0.5	10	10	0.5	0.5	**0.9516**	0.9418	0.9425	**0.9510**	**0.9996**	***0.0066***	0.0230	0.0324	***0.0066***	0.0436
100	200	0.5	1	1	1	0.3	0.3	**0.9602**	0.9216	**0.9480**	**0.9600**	**0.9600**	0.6942	2.6112	3.4646	***0.6932***	1.1920
100	200	0.5	1	1	1	0.3	0.5	**0.9520**	0.9324	0.9376	**0.9520**	**0.9832**	0.4387	1.4583	2.1868	***0.4381***	1.4650
100	200	0.5	1	1	1	0.5	0.5	**0.9488**	0.9402	0.9429	**0.9488**	**0.9844**	0.2963	0.9300	1.4607	***0.2960***	1.4740
100	200	0.5	1	1	5	0.3	0.3	**0.9500**	**0.9464**	0.9427	**0.9494**	**0.9956**	0.2008	0.5472	1.0100	***0.2004***	0.2583
100	200	0.5	1	1	5	0.3	0.5	**0.9516**	**0.9508**	0.9365	**0.9516**	**0.9996**	0.1257	0.3462	0.6224	***0.1255***	0.3271
100	200	0.5	1	1	5	0.5	0.5	**0.9500**	**0.9462**	**0.9493**	**0.9500**	**1.0000**	0.0811	0.2215	0.4134	***0.0810***	0.3618
100	200	0.5	1	5	5	0.3	0.3	**0.9596**	0.9368	**0.9490**	**0.9594**	**0.9774**	0.1388	0.3433	0.6834	***0.1386***	0.1873
100	200	0.5	1	5	5	0.3	0.5	**0.9544**	**0.9452**	0.9352	**0.9544**	**0.9928**	0.0877	0.2288	0.4295	***0.0876***	0.2735
100	200	0.5	1	5	5	0.5	0.5	**0.9480**	**0.9472**	**0.9464**	**0.9478**	**0.9964**	0.0593	0.1580	0.2891	***0.0592***	0.2764
100	200	0.5	1	5	10	0.3	0.3	**0.9614**	0.9348	**0.9491**	**0.9614**	**0.9840**	0.0748	0.1934	0.3807	***0.0747***	0.1110
100	200	0.5	1	5	10	0.3	0.5	**0.9558**	0.9448	0.9375	**0.9556**	**0.9968**	0.0470	0.1323	0.2368	***0.0469***	0.1628
100	200	0.5	1	5	10	0.5	0.5	**0.9512**	0.9438	0.9392	**0.9506**	**0.9974**	0.0313	0.0922	0.1499	***0.0312***	0.1682
100	200	0.5	1	10	10	0.3	0.3	**0.9602**	0.9342	0.9392	**0.9602**	**0.9782**	0.0693	0.1840	0.3500	***0.0692***	0.1076
100	200	0.5	1	10	10	0.3	0.5	**0.9554**	**0.9450**	0.9436	**0.9548**	**0.9958**	0.0439	0.1263	0.2126	***0.0438***	0.1603
100	200	0.5	1	10	10	0.5	0.5	**0.9476**	0.9434	0.9438	**0.9474**	**0.9972**	***0.0296***	0.0885	0.1442	***0.0296***	0.1626
100	200	1	1	1	1	0.3	0.3	**0.9520**	0.9424	0.9381	**0.9516**	**0.9966**	1.3099	5.9758	6.2398	***1.3077***	2.1190
100	200	1	1	1	1	0.3	0.5	**0.9482**	**0.9500**	0.9380	**0.9480**	**1.0000**	0.8301	3.2084	4.1907	***0.8289***	2.3060
100	200	1	1	1	1	0.5	0.5	**0.9498**	**0.9504**	0.9419	**0.9494**	**1.0000**	0.5307	1.8306	2.6098	***0.5300***	2.6580

Table 7. *Cont.*

Parameters								Coverage Probabilities (θ)					Average Widths (θ)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
100	200	1	1	1	5	0.3	0.3	**0.9550**	0.9036	0.9419	**0.9546**	0.9346	1.0268	4.4348	5.2364	***1.0251***	1.6930
100	200	1	1	1	5	0.3	0.5	**0.9498**	0.9274	0.9413	**0.9492**	0.9410	0.6778	2.5250	3.1904	***0.6769***	1.7170
100	200	1	1	1	5	0.5	0.5	**0.9508**	0.9374	0.9430	**0.9508**	**0.9632**	0.4341	1.4592	2.1860	***0.4336***	2.1340
100	200	1	1	5	5	0.3	0.3	**0.9470**	0.9410	0.9430	**0.9470**	**0.9900**	0.2620	0.6201	1.2658	***0.2616***	0.3196
100	200	1	1	5	5	0.3	0.5	**0.9486**	**0.9466**	0.9426	**0.9486**	**0.9990**	0.1659	0.4167	0.8058	***0.1656***	0.3791
100	200	1	1	5	5	0.5	0.5	**0.9520**	**0.9458**	0.9372	**0.9514**	**0.9992**	0.1061	0.2770	0.5171	***0.1060***	0.4738
100	200	1	1	5	10	0.3	0.3	**0.9528**	0.9306	**0.9474**	**0.9526**	**0.9760**	0.2214	0.5233	1.0845	***0.2210***	0.2817
100	200	1	1	5	10	0.3	0.5	**0.9518**	0.9442	0.9361	**0.9516**	**0.9906**	0.1433	0.3620	0.6898	***0.1431***	0.3082
100	200	1	1	5	10	0.5	0.5	**0.9518**	**0.9474**	**0.9499**	**0.9516**	**0.9982**	0.0915	0.2418	0.4534	***0.0914***	0.4170
100	200	1	1	10	10	0.3	0.3	**0.9502**	0.9370	0.9396	**0.9498**	**0.9882**	0.1310	0.3168	0.6461	***0.1308***	0.1829
100	200	1	1	10	10	0.3	0.5	**0.9496**	**0.9462**	**0.9450**	**0.9494**	**0.9972**	0.0829	0.2223	0.3949	***0.0828***	0.2180
100	200	1	1	10	10	0.5	0.5	**0.9506**	0.9432	0.9389	**0.9506**	**0.9990**	***0.0530***	0.1524	0.2655	***0.0530***	0.2751

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 8. The coverage probabilities and average widths of the 95% confidence intervals for the ratio of variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (30, 30).

Parameters								Coverage Probabilities (η)					Average Widths (η)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
30	30	0.5	0.5	1	1	0.3	0.3	0.9436	**0.9522**	**0.9560**	0.9434	0.2894	1.2973	3.9437	***3.0356***	1.2956	0.5054
30	30	0.5	0.5	1	1	0.3	0.5	**0.9508**	**0.9462**	0.9365	**0.9508**	0.3076	0.9211	2.5168	2.0473	***0.9199***	0.6020
30	30	0.5	0.5	1	1	0.5	0.5	**0.9540**	**0.9496**	0.9359	**0.9538**	0.3486	0.6167	1.5646	1.5244	***0.6160***	0.6900
30	30	0.5	0.5	1	5	0.3	0.3	**0.9466**	0.9394	**0.9492**	**0.9464**	0.1228	2.0369	5.2089	4.7651	***2.0340***	0.3468
30	30	0.5	0.5	1	5	0.3	0.5	**0.9506**	0.9364	0.9436	**0.9502**	0.1386	1.4311	3.4913	3.2759	***1.4292***	0.3553
30	30	0.5	0.5	1	5	0.5	0.5	**0.9534**	**0.9464**	**0.9465**	**0.9528**	0.1814	0.9492	2.2709	2.3015	***0.9481***	0.4688
30	30	0.5	0.5	5	5	0.3	0.3	**0.9466**	**0.9500**	0.9391	**0.9460**	0.1322	0.5267	1.0708	1.2783	***0.5259***	0.0990
30	30	0.5	0.5	5	5	0.3	0.5	**0.9514**	0.9432	0.9436	**0.9512**	0.1892	0.3736	0.7854	0.8904	***0.3731***	0.1257
30	30	0.5	0.5	5	5	0.5	0.5	**0.9514**	**0.9470**	0.9352	**0.9512**	0.2000	0.2488	0.5417	0.6038	***0.2485***	0.1501
30	30	0.5	0.5	5	10	0.3	0.3	**0.9452**	**0.9458**	0.9354	**0.9452**	0.1098	0.5071	1.0341	1.1738	***0.5064***	0.0840
30	30	0.5	0.5	5	10	0.3	0.5	**0.9510**	0.9442	0.9417	**0.9508**	0.1502	0.3545	0.7585	0.8529	***0.3540***	0.0970
30	30	0.5	0.5	5	10	0.5	0.5	**0.9560**	0.9438	0.9377	**0.9558**	0.1864	0.2337	0.5230	0.5205	***0.2334***	0.1244
30	30	0.5	0.5	10	10	0.3	0.3	**0.9448**	**0.9448**	0.9415	0.9446	0.1110	***0.3101***	0.6691	0.6911	0.3096	0.0682
30	30	0.5	0.5	10	10	0.3	0.5	**0.9502**	0.9432	0.9399	**0.9498**	0.1654	0.2175	0.5015	0.5084	***0.2173***	0.0821
30	30	0.5	0.5	10	10	0.5	0.5	**0.9518**	0.9442	0.9403	**0.9514**	0.1878	0.1436	0.3498	0.3214	***0.1434***	0.0943
30	30	0.5	1	1	1	0.3	0.3	**0.9484**	**0.9454**	**0.9462**	**0.9480**	**0.9528**	0.2245	0.9125	0.5430	***0.2242***	3.4710
30	30	0.5	1	1	1	0.3	0.5	**0.9510**	**0.9456**	**0.9456**	**0.9508**	0.9254	0.1591	0.5451	0.3711	***0.1589***	4.4720
30	30	0.5	1	1	1	0.5	0.5	**0.9530**	**0.9490**	0.9449	**0.9526**	0.9352	0.1065	0.3206	0.2559	***0.1063***	4.4980
30	30	0.5	1	1	5	0.3	0.3	**0.9468**	**0.9474**	**0.9487**	**0.9464**	0.8466	0.4439	1.1622	1.0211	***0.4433***	0.6174
30	30	0.5	1	1	5	0.3	0.5	**0.9494**	0.9398	0.9390	**0.9490**	0.8762	0.3132	0.7703	0.6933	***0.3128***	0.7957
30	30	0.5	1	1	5	0.5	0.5	**0.9552**	**0.9474**	**0.9454**	**0.9550**	0.9218	0.2086	0.4968	0.5055	***0.2083***	0.8851
30	30	0.5	1	5	5	0.3	0.3	**0.9486**	**0.9500**	0.9390	**0.9484**	0.9364	0.1314	0.2793	0.3056	***0.1312***	0.4861
30	30	0.5	1	5	5	0.3	0.5	**0.9508**	**0.9450**	0.9369	**0.9508**	**0.9598**	0.0956	0.2041	0.2333	***0.0954***	0.7164
30	30	0.5	1	5	5	0.5	0.5	**0.9542**	**0.9514**	0.9351	**0.9538**	**0.9584**	0.0649	0.1404	0.1432	***0.0648***	0.7060
30	30	0.5	1	5	10	0.3	0.3	**0.9466**	**0.9500**	0.9418	**0.9460**	0.9052	0.1317	0.2677	0.2955	***0.1315***	0.2817
30	30	0.5	1	5	10	0.3	0.5	**0.9514**	0.9432	0.9438	**0.9512**	**0.9570**	0.0934	0.1964	0.2311	***0.0933***	0.4118
30	30	0.5	1	5	10	0.5	0.5	**0.9514**	**0.9470**	0.9355	**0.9512**	**0.9572**	0.0622	0.1354	0.1374	***0.0621***	0.4244
30	30	0.5	1	10	10	0.3	0.3	**0.9506**	**0.9492**	**0.9484**	**0.9506**	0.9146	0.0896	0.1885	0.2060	***0.0895***	0.2794
30	30	0.5	1	10	10	0.3	0.5	**0.9536**	**0.9452**	0.9395	**0.9536**	**0.9704**	0.0648	0.1415	0.1462	***0.0647***	0.4119
30	30	0.5	1	10	10	0.5	0.5	**0.9528**	**0.9466**	0.9428	**0.9526**	**0.9624**	0.0437	0.0988	0.1046	***0.0436***	0.4138
30	30	1	1	1	1	0.3	0.3	**0.9478**	**0.9486**	0.9307	**0.9476**	0.9016	1.6384	8.7653	2.9341	***1.6361***	5.4600
30	30	1	1	1	1	0.3	0.5	**0.9518**	**0.9480**	**0.9497**	**0.9518**	0.8444	1.1496	4.7377	2.5755	***1.1481***	6.4530
30	30	1	1	1	1	0.5	0.5	**0.9532**	**0.9472**	0.9445	**0.9530**	0.8904	0.7648	2.6037	1.8186	***0.7639***	6.9950
30	30	1	1	1	5	0.3	0.3	**0.9460**	0.9302	0.9435	**0.9456**	0.5684	3.3885	12.6422	8.0805	***3.3836***	3.5320
30	30	1	1	1	5	0.3	0.5	**0.9490**	0.9318	**0.9465**	**0.9486**	0.5614	2.3840	7.6535	5.8014	***2.3809***	3.6680
30	30	1	1	1	5	0.5	0.5	**0.9560**	**0.9496**	0.9350	**0.9560**	0.6744	1.5860	4.6318	3.5059	***1.5841***	4.5900
30	30	1	1	5	5	0.3	0.3	**0.9476**	**0.9544**	**0.9484**	**0.9474**	0.6340	0.8254	1.7870	1.8230	***0.8242***	0.7047
30	30	1	1	5	5	0.3	0.5	**0.9502**	**0.9466**	**0.9493**	**0.9500**	0.7214	0.5889	1.2608	1.3478	***0.5882***	0.8939
30	30	1	1	5	5	0.5	0.5	**0.9522**	**0.9498**	0.9431	**0.9522**	0.7758	0.3948	0.8491	0.8703	***0.3944***	1.0450
30	30	1	1	5	10	0.3	0.3	**0.9472**	**0.9472**	0.9381	**0.9468**	0.4844	0.8919	1.8551	2.0199	***0.8906***	0.5676
30	30	1	1	5	10	0.3	0.5	**0.9518**	0.9446	**0.9494**	**0.9518**	0.5696	0.6275	1.3180	1.4738	***0.6267***	0.6495
30	30	1	1	5	10	0.5	0.5	**0.9532**	**0.9466**	0.9430	**0.9532**	0.6594	0.4162	0.8919	1.0172	***0.4157***	0.8377
30	30	1	1	10	10	0.3	0.3	**0.9466**	**0.9500**	0.9407	**0.9460**	0.4962	0.5267	1.0708	1.1762	***0.5259***	0.3933
30	30	1	1	10	10	0.3	0.5	**0.9514**	0.9432	**0.9455**	**0.9512**	0.6610	0.3736	0.7854	0.9216	***0.3731***	0.5021
30	30	1	1	10	10	0.5	0.5	**0.9514**	**0.9470**	0.9362	**0.9512**	0.7054	0.2488	0.5417	0.5737	***0.2485***	0.5974

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 9. The coverage probabilities and average widths of the 95% confidence intervals for the ratio of variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (50, 50).

Parameters								Coverage Probabilities (η)					Average Widths (η)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
50	50	0.5	0.5	1	1	0.3	0.3	**0.9488**	**0.9520**	0.9439	**0.9486**	0.2764	0.4251	1.0340	1.0490	***0.4246***	0.3735
50	50	0.5	0.5	1	1	0.3	0.5	**0.9524**	**0.9498**	0.9369	**0.9520**	0.2792	1.1693	3.3202	2.6414	***1.1677***	0.4407
50	50	0.5	0.5	1	1	0.5	0.5	**0.9468**	**0.9490**	0.9352	**0.9464**	0.3228	0.8100	2.1059	1.8149	***0.8090***	0.5022
50	50	0.5	0.5	1	5	0.3	0.3	**0.9472**	**0.9482**	0.9439	**0.9470**	0.1276	0.6510	1.5320	1.4478	***0.6502***	0.2580
50	50	0.5	0.5	1	5	0.3	0.5	**0.9514**	0.9360	0.9441	**0.9514**	0.1470	1.9760	4.9840	4.6775	***1.9732***	0.2653
50	50	0.5	0.5	1	5	0.5	0.5	**0.9510**	0.9424	**0.9454**	**0.9506**	0.1930	1.3897	3.3931	3.4586	***1.3879***	0.3474
50	50	0.5	0.5	5	5	0.3	0.3	**0.9500**	**0.9472**	0.9362	**0.9496**	0.1390	0.1708	0.3780	0.4112	***0.1706***	0.0758
50	50	0.5	0.5	5	5	0.3	0.5	**0.9508**	0.9440	0.9351	**0.9506**	0.1826	0.4708	0.9545	1.1386	***0.4701***	0.0963
50	50	0.5	0.5	5	5	0.5	0.5	**0.9478**	**0.9468**	0.9434	**0.9476**	0.1954	0.3247	0.6869	0.7930	***0.3243***	0.1142
50	50	0.5	0.5	5	10	0.3	0.3	**0.9488**	**0.9468**	0.9362	**0.9484**	0.1100	0.1597	0.3649	0.3927	***0.1595***	0.0649
50	50	0.5	0.5	5	10	0.3	0.5	**0.9536**	0.9444	0.9383	**0.9536**	0.1548	0.4756	0.9666	1.1688	***0.4749***	0.0740
50	50	0.5	0.5	5	10	0.5	0.5	**0.9520**	**0.9480**	0.9441	**0.9510**	0.1914	0.3305	0.7061	0.7952	***0.3300***	0.0954
50	50	0.5	0.5	10	10	0.3	0.3	**0.9502**	0.9446	**0.9454**	**0.9502**	0.1094	0.0981	0.2456	0.2330	***0.0980***	0.0523
50	50	0.5	0.5	10	10	0.3	0.5	**0.9510**	0.9436	**0.9489**	**0.9508**	0.1610	0.2728	0.5980	0.6710	***0.2724***	0.0630
50	50	0.5	0.5	10	10	0.5	0.5	**0.9468**	**0.9498**	0.9434	**0.9468**	0.2002	0.1868	0.4378	0.4531	***0.1866***	0.0722
50	50	0.5	1	1	1	0.3	0.3	**0.9492**	**0.9526**	0.9413	**0.9492**	**0.9730**	0.0734	0.2049	0.1760	***0.0733***	2.5060
50	50	0.5	1	1	1	0.3	0.5	**0.9514**	**0.9500**	0.9387	**0.9508**	**0.9598**	0.1962	0.6900	0.4383	***0.1959***	3.2520
50	50	0.5	1	1	1	0.5	0.5	**0.9458**	**0.9528**	0.9421	**0.9458**	**0.9702**	0.1346	0.4030	0.2980	***0.1344***	3.2320
50	50	0.5	1	1	5	0.3	0.3	**0.9488**	**0.9500**	0.9394	**0.9482**	0.8312	0.1433	0.3337	0.3497	***0.1431***	0.4595
50	50	0.5	1	1	5	0.3	0.5	**0.9522**	0.9408	0.9367	**0.9522**	0.8980	0.4182	1.0719	0.9575	***0.4176***	0.6143
50	50	0.5	1	1	5	0.5	0.5	**0.9482**	**0.9462**	0.9420	**0.9482**	0.9328	0.2924	0.7161	0.6920	***0.2920***	0.6628
50	50	0.5	1	5	5	0.3	0.3	**0.9494**	**0.9484**	**0.9455**	**0.9492**	**0.9556**	0.0451	0.0978	0.1122	***0.0450***	0.3747
50	50	0.5	1	5	5	0.3	0.5	**0.9504**	0.9438	**0.9451**	**0.9496**	**0.9820**	0.1127	0.2350	0.2616	***0.1126***	0.5485
50	50	0.5	1	5	5	0.5	0.5	**0.9466**	**0.9462**	**0.9496**	**0.9462**	**0.9742**	***0.0778***	0.1653	0.1799	***0.0778***	0.5472
50	50	0.5	1	5	10	0.3	0.3	**0.9500**	**0.9472**	**0.9498**	**0.9496**	0.9124	***0.0427***	0.0945	0.0960	***0.0427***	0.2175
50	50	0.5	1	5	10	0.3	0.5	**0.9508**	0.9440	0.9381	**0.9506**	**0.9678**	0.1177	0.2386	0.2641	***0.1175***	0.3195
50	50	0.5	1	5	10	0.5	0.5	**0.9478**	**0.9468**	0.9432	**0.9476**	**0.9720**	0.0812	0.1717	0.1802	***0.0811***	0.3264
50	50	0.5	1	10	10	0.3	0.3	**0.9502**	**0.9474**	0.9366	**0.9502**	0.9390	***0.0302***	0.0694	0.0688	***0.0302***	0.2151
50	50	0.5	1	10	10	0.3	0.5	**0.9506**	0.9414	**0.9487**	**0.9502**	**0.9802**	0.0750	0.1599	0.1742	***0.0749***	0.3187
50	50	0.5	1	10	10	0.5	0.5	**0.9454**	**0.9508**	**0.9457**	**0.9450**	**0.9832**	0.0514	0.1150	0.1183	***0.0513***	0.3214
50	50	1	1	1	1	0.3	0.3	**0.9480**	**0.9484**	**0.9452**	**0.9476**	0.9258	0.5251	1.6053	1.2833	***0.5245***	3.8540
50	50	1	1	1	1	0.3	0.5	**0.9498**	**0.9480**	**0.9489**	**0.9494**	0.8616	1.4613	6.9263	3.3759	***1.4593***	4.3640
50	50	1	1	1	1	0.5	0.5	**0.9474**	**0.9492**	**0.9461**	**0.9468**	0.9264	1.0046	3.7180	2.3135	***1.0033***	5.0360
50	50	1	1	1	5	0.3	0.3	**0.9482**	0.9444	0.9421	**0.9478**	0.5744	1.0885	3.0135	2.5361	***1.0872***	2.5640
50	50	1	1	1	5	0.3	0.5	**0.9488**	0.9262	0.9398	**0.9486**	0.5838	3.2420	11.9997	7.2801	***3.2375***	2.6260
50	50	1	1	1	5	0.5	0.5	**0.9490**	0.9358	0.9391	**0.9488**	0.7024	2.2757	7.3488	5.3617	***2.2727***	3.2860
50	50	1	1	5	5	0.3	0.3	**0.9488**	**0.9496**	0.9432	**0.9486**	0.6342	0.2722	0.5849	0.6626	***0.2719***	0.5395
50	50	1	1	5	5	0.3	0.5	**0.9508**	**0.9450**	**0.9473**	**0.9506**	0.7328	0.7453	1.5726	1.8215	***0.7443***	0.6754
50	50	1	1	5	5	0.5	0.5	**0.9476**	**0.9506**	0.9426	**0.9472**	0.7810	0.5169	1.0946	1.2495	***0.5162***	0.7951
50	50	1	1	5	10	0.3	0.3	**0.9484**	**0.9530**	0.9387	**0.9482**	0.4790	0.2853	0.6157	0.6699	***0.2850***	0.4310
50	50	1	1	5	10	0.3	0.5	**0.9524**	**0.9450**	**0.9489**	**0.9520**	0.5856	0.8372	1.7219	1.8642	***0.8361***	0.4954
50	50	1	1	5	10	0.5	0.5	**0.9474**	**0.9504**	0.9397	**0.9472**	0.6758	0.5837	1.2250	1.3741	***0.5829***	0.6403
50	50	1	1	10	10	0.3	0.3	**0.9500**	**0.9472**	0.9391	**0.9496**	0.5090	0.1708	0.3780	0.3761	***0.1706***	0.3022
50	50	1	1	10	10	0.3	0.5	**0.9508**	0.9440	**0.9482**	**0.9506**	0.6590	0.4708	0.9545	1.1281	***0.4701***	0.3842
50	50	1	1	10	10	0.5	0.5	**0.9478**	**0.9468**	**0.9450**	**0.9476**	0.7090	0.3247	0.6869	0.7238	***0.3243***	0.4548

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 10. The coverage probabilities and average widths of the 95% confidence intervals for the ratio of variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (100, 100).

Parameters								Coverage Probabilities (η)					Average Widths (η)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
100	100	0.5	0.5	1	1	0.3	0.3	**0.9492**	**0.9456**	0.9438	**0.9490**	0.2690	0.5369	1.3204	1.2699	***0.5362***	0.2532
100	100	0.5	0.5	1	1	0.3	0.5	**0.9482**	**0.9476**	**0.9466**	**0.9482**	0.2804	1.4227	4.7839	3.4285	***1.4207***	0.3019
100	100	0.5	0.5	1	1	0.5	0.5	**0.9468**	0.9400	0.9393	**0.9464**	0.3316	1.0106	3.0373	2.4893	***1.0094***	0.3403
100	100	0.5	0.5	1	5	0.3	0.3	**0.9508**	0.9416	0.9407	**0.9506**	0.1282	0.9160	2.1738	2.0714	***0.9150***	0.1798
100	100	0.5	0.5	1	5	0.3	0.5	**0.9486**	0.9376	0.9393	**0.9486**	0.1396	1.8624	4.9465	4.5410	***1.8596***	0.1853
100	100	0.5	0.5	1	5	0.5	0.5	**0.9536**	0.9396	0.9436	**0.9524**	0.1874	1.3045	3.3241	3.1800	***1.3028***	0.2399
100	100	0.5	0.5	5	5	0.3	0.3	**0.9504**	**0.9484**	0.9434	**0.9500**	0.1322	0.2153	0.4687	0.5282	***0.2150***	0.0529
100	100	0.5	0.5	5	5	0.3	0.5	**0.9462**	0.9430	0.9377	**0.9462**	0.1916	0.4660	1.0372	1.0629	***0.4653***	0.0677
100	100	0.5	0.5	5	5	0.5	0.5	**0.9446**	0.9416	0.9411	0.9444	0.2114	***0.3239***	0.7680	0.7197	0.3234	0.0799
100	100	0.5	0.5	5	10	0.3	0.3	**0.9492**	**0.9478**	**0.9464**	**0.9490**	0.1098	0.2178	0.4818	0.5237	***0.2176***	0.0452
100	100	0.5	0.5	5	10	0.3	0.5	**0.9492**	**0.9456**	0.9421	**0.9484**	0.1460	0.4362	0.9463	1.0545	***0.4355***	0.0517
100	100	0.5	0.5	5	10	0.5	0.5	**0.9490**	0.9434	0.9402	**0.9486**	0.1886	0.3014	0.7000	0.6969	***0.3010***	0.0667
100	100	0.5	0.5	10	10	0.3	0.3	**0.9504**	**0.9520**	0.9436	**0.9502**	0.1112	0.1235	0.3028	0.2730	***0.1234***	0.0365
100	100	0.5	0.5	10	10	0.3	0.5	**0.9462**	0.9426	0.9361	**0.9460**	0.1640	0.2588	0.6222	0.5970	***0.2584***	0.0439
100	100	0.5	0.5	10	10	0.5	0.5	**0.9468**	**0.9450**	**0.9494**	**0.9466**	0.2108	0.1771	0.4708	0.4089	***0.1768***	0.0506
100	100	0.5	1	1	1	0.3	0.3	**0.9514**	0.9444	**0.9459**	**0.9506**	**0.9954**	0.0893	0.2464	0.2193	***0.0892***	1.6950

Table 10. *Cont.*

Parameters								Coverage Probabilities (η)					Average Widths (η)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
100	100	0.5	1	1	1	0.3	0.5	**0.9488**	0.9376	**0.9466**	**0.9488**	**0.9876**	0.2747	1.3001	0.6499	***0.2744***	2.1550
100	100	0.5	1	1	1	0.5	0.5	**0.9460**	0.9360	0.9402	**0.9456**	**0.9924**	0.1958	0.7621	0.4684	***0.1955***	2.1560
100	100	0.5	1	1	5	0.3	0.3	**0.9480**	0.9436	0.9380	**0.9480**	0.8356	0.1932	0.4571	0.4354	***0.1929***	0.3161
100	100	0.5	1	1	5	0.3	0.5	**0.9478**	0.9422	**0.9472**	**0.9476**	0.9170	0.4309	1.2000	0.9934	***0.4302***	0.4293
100	100	0.5	1	1	5	0.5	0.5	**0.9474**	0.9424	**0.9469**	**0.9470**	0.9414	0.3028	0.7960	0.7002	***0.3024***	0.4564
100	100	0.5	1	5	5	0.3	0.3	**0.9518**	**0.9494**	**0.9473**	**0.9516**	**0.9760**	0.0523	0.1129	0.1178	***0.0523***	0.2618
100	100	0.5	1	5	5	0.3	0.5	**0.9468**	0.9398	0.9444	**0.9468**	**0.9938**	0.1240	0.2941	0.3019	***0.1238***	0.3855
100	100	0.5	1	5	5	0.5	0.5	0.9442	0.9356	0.9390	0.9440	**0.9924**	0.0884	0.2170	0.2178	0.0883	***0.3866***
100	100	0.5	1	5	10	0.3	0.3	**0.9504**	**0.9484**	**0.9478**	**0.9500**	0.9392	***0.0538***	0.1172	0.1280	***0.0538***	0.1535
100	100	0.5	1	5	10	0.3	0.5	**0.9462**	0.9430	0.9364	**0.9462**	**0.9798**	0.1165	0.2593	0.2590	***0.1163***	0.2255
100	100	0.5	1	5	10	0.5	0.5	0.9446	0.9416	0.9381	0.9444	**0.9802**	0.0810	0.1920	0.2020	0.0809	***0.2317***
100	100	0.5	1	10	10	0.3	0.3	**0.9516**	**0.9510**	**0.9497**	**0.9510**	**0.9656**	0.0345	0.0796	0.0808	***0.0345***	0.1507
100	100	0.5	1	10	10	0.3	0.5	**0.9476**	0.9370	**0.9450**	**0.9474**	**0.9928**	0.0770	0.1849	0.1908	***0.0769***	0.2262
100	100	0.5	1	10	10	0.5	0.5	0.9444	0.9362	0.9381	0.9444	**0.9908**	0.0539	0.1401	0.1271	0.0538	***0.2250***
100	100	1	1	1	1	0.3	0.3	**0.9486**	**0.9482**	**0.9480**	**0.9482**	0.9422	0.6634	2.1206	1.5632	***0.6626***	2.5200
100	100	1	1	1	1	0.3	0.5	**0.9498**	0.9444	**0.9485**	**0.9496**	0.9050	2.0000	12.6667	4.4066	***1.9972***	2.8340
100	100	1	1	1	1	0.5	0.5	**0.9458**	**0.9458**	**0.9487**	**0.9452**	**0.9470**	1.4115	6.5376	3.2232	***1.4097***	3.1690
100	100	1	1	1	5	0.3	0.3	**0.9494**	0.9358	**0.9489**	**0.9490**	0.5936	1.5016	4.3935	3.5057	***1.4998***	1.7180
100	100	1	1	1	5	0.3	0.5	**0.9480**	0.9320	0.9413	**0.9476**	0.5868	3.3040	13.3281	7.3678	***3.2993***	1.7430
100	100	1	1	1	5	0.5	0.5	**0.9488**	0.9354	0.9369	**0.9484**	0.7220	2.3219	7.8848	5.5421	***2.3189***	2.1680
100	100	1	1	5	5	0.3	0.3	**0.9496**	**0.9502**	**0.9484**	**0.9494**	0.6316	0.3434	0.7315	0.8230	***0.3430***	0.3706
100	100	1	1	5	5	0.3	0.5	**0.9468**	0.9444	0.9372	**0.9466**	0.7186	0.7926	1.8607	1.7604	***0.7915***	0.4706
100	100	1	1	5	5	0.5	0.5	**0.9450**	0.9420	0.9382	0.9446	0.7778	***0.5584***	1.3239	1.3405	0.5577	0.5525
100	100	1	1	5	10	0.3	0.3	**0.9500**	**0.9466**	0.9431	**0.9498**	0.4768	0.3854	0.8198	0.9199	***0.3849***	0.3017
100	100	1	1	5	10	0.3	0.5	**0.9478**	**0.9484**	0.9361	**0.9476**	0.5936	0.8056	1.7742	1.9970	***0.8044***	0.3472
100	100	1	1	5	10	0.5	0.5	**0.9482**	0.9444	**0.9479**	**0.9480**	0.6828	0.5611	1.2710	1.3563	***0.5603***	0.4488
100	100	1	1	10	10	0.3	0.3	**0.9504**	**0.9484**	0.9364	**0.9500**	0.5120	0.2153	0.4687	0.5219	***0.2150***	0.2114
100	100	1	1	10	10	0.3	0.5	**0.9462**	0.9430	0.9419	**0.9462**	0.6564	0.4660	1.0372	1.1181	***0.4653***	0.2692
100	100	1	1	10	10	0.5	0.5	**0.9446**	0.9416	0.9435	0.9444	0.7220	***0.3239***	0.7680	0.7357	0.3234	0.3187

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 11. The coverage probabilities and average widths of the 95% confidence intervals for the ratio of variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (200, 200).

Parameters								Coverage Probabilities (η)					Average Widths (η)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
200	200	0.5	0.5	1	1	0.3	0.3	**0.9476**	**0.9494**	0.9441	**0.9476**	0.2786	0.6748	1.8439	1.5607	***0.6740***	0.1757
200	200	0.5	0.5	1	1	0.3	0.5	**0.9464**	**0.9486**	0.9409	**0.9464**	0.2698	0.4643	1.2144	1.1495	***0.4638***	0.2063
200	200	0.5	0.5	1	1	0.5	0.5	**0.9534**	**0.9472**	0.9394	**0.9534**	0.3236	1.2733	3.8381	2.9342	***1.2716***	0.2337
200	200	0.5	0.5	1	5	0.3	0.3	**0.9480**	**0.9460**	**0.9498**	**0.9478**	0.1262	0.8640	2.1294	1.9475	***0.8630***	0.1255
200	200	0.5	0.5	1	5	0.3	0.5	**0.9464**	**0.9502**	0.9447	**0.9460**	0.1422	0.5924	1.4443	1.3258	***0.5917***	0.1297
200	200	0.5	0.5	1	5	0.5	0.5	**0.9506**	0.9366	0.9368	**0.9502**	0.1828	1.8009	4.6451	4.2693	***1.7983***	0.1678
200	200	0.5	0.5	5	5	0.3	0.3	0.9446	**0.9490**	**0.9461**	0.9446	0.1350	0.2124	0.5249	***0.4988***	0.2121	0.0371
200	200	0.5	0.5	5	5	0.3	0.5	**0.9506**	**0.9560**	0.9418	**0.9496**	0.1938	0.1448	0.3672	0.3411	***0.1447***	0.0476
200	200	0.5	0.5	5	5	0.5	0.5	**0.9542**	**0.9480**	0.9447	**0.9538**	0.2106	0.4147	0.9154	0.9692	***0.4141***	0.0563
200	200	0.5	0.5	5	10	0.3	0.3	**0.9470**	**0.9512**	0.9387	**0.9466**	0.1074	0.1975	0.4795	0.4510	***0.1973***	0.0319
200	200	0.5	0.5	5	10	0.3	0.5	**0.9494**	**0.9532**	0.9380	**0.9486**	0.1584	0.1349	0.3358	0.3354	***0.1347***	0.0363
200	200	0.5	0.5	5	10	0.5	0.5	**0.9544**	**0.9466**	0.9412	**0.9542**	0.1846	0.4079	0.8757	1.0144	***0.4073***	0.0469
200	200	0.5	0.5	10	10	0.3	0.3	**0.9452**	**0.9492**	0.9424	**0.9450**	0.1142	0.1149	0.3274	0.2726	***0.1148***	0.0257
200	200	0.5	0.5	10	10	0.3	0.5	**0.9488**	**0.9508**	0.9401	**0.9486**	0.1722	0.0780	0.2304	0.1812	***0.0779***	0.0311
200	200	0.5	0.5	10	10	0.5	0.5	**0.9530**	**0.9468**	**0.9482**	**0.9528**	0.2058	0.2273	0.5514	0.5450	***0.2269***	0.0354
200	200	0.5	1	1	1	0.3	0.3	**0.9464**	**0.9454**	0.9447	**0.9464**	**0.9986**	0.1311	0.4303	0.3077	***0.1309***	1.1750
200	200	0.5	1	1	1	0.3	0.5	**0.9488**	**0.9500**	0.9355	**0.9484**	**0.9970**	0.0903	0.2718	0.2035	***0.0902***	1.4680
200	200	0.5	1	1	1	0.5	0.5	**0.9528**	**0.9478**	**0.9474**	**0.9524**	**0.9966**	0.2369	0.9231	0.5709	***0.2366***	1.4590
200	200	0.5	1	1	5	0.3	0.3	**0.9466**	0.9448	**0.9465**	**0.9460**	0.8324	0.2007	0.5036	0.4670	***0.2004***	0.2229
200	200	0.5	1	1	5	0.3	0.5	**0.9494**	**0.9522**	0.9355	**0.9492**	0.9276	0.1376	0.3396	0.3084	***0.1374***	0.2996
200	200	0.5	1	1	5	0.5	0.5	**0.9514**	0.9396	0.9361	**0.9510**	0.9428	0.4046	1.0779	0.9367	***0.4040***	0.3169
200	200	0.5	1	5	5	0.3	0.3	**0.9472**	0.9434	**0.9492**	**0.9468**	**0.9868**	0.0590	0.1473	0.1341	***0.0589***	0.1850
200	200	0.5	1	5	5	0.3	0.5	**0.9492**	**0.9504**	0.9424	**0.9488**	**0.9970**	0.0406	0.1028	0.0918	***0.0405***	0.2732
200	200	0.5	1	5	5	0.5	0.5	**0.9528**	**0.9508**	0.9369	**0.9524**	**0.9968**	0.1057	0.2450	0.2446	***0.1055***	0.2740
200	200	0.5	1	5	10	0.3	0.3	0.9446	**0.9490**	0.9369	0.9446	**0.9454**	0.0531	0.1312	0.1295	0.0530	***0.1076***
200	200	0.5	1	5	10	0.3	0.5	**0.9506**	**0.9560**	**0.9491**	**0.9496**	**0.9910**	***0.0362***	0.0918	0.0830	***0.0362***	0.1602
200	200	0.5	1	5	10	0.5	0.5	**0.9542**	**0.9480**	0.9408	**0.9538**	**0.9874**	0.1037	0.2288	0.2469	***0.1035***	0.1635
200	200	0.5	1	10	10	0.3	0.3	**0.9470**	**0.9486**	0.9407	**0.9470**	**0.9714**	***0.0354***	0.0973	0.0864	***0.0354***	0.1058
200	200	0.5	1	10	10	0.3	0.5	**0.9506**	**0.9510**	0.9398	**0.9504**	**0.9956**	***0.0242***	0.0684	0.0589	***0.0242***	0.1591
200	200	0.5	1	10	10	0.5	0.5	**0.9518**	**0.9452**	0.9394	**0.9516**	**0.9986**	0.0640	0.1561	0.1526	***0.0639***	0.1600
200	200	1	1	1	1	0.3	0.3	**0.9478**	**0.9516**	0.9369	**0.9474**	**0.9606**	0.9391	3.4359	2.2059	***0.9380***	1.7040
200	200	1	1	1	1	0.3	0.5	**0.9482**	**0.9544**	**0.9472**	**0.9480**	0.9234	0.6446	2.0902	1.5977	***0.6439***	1.9210
200	200	1	1	1	1	0.5	0.5	**0.9536**	**0.9468**	0.9433	**0.9534**	**0.9692**	1.7615	8.8732	4.1629	***1.7591***	2.1010

Table 11. *Cont.*

Parameters								Coverage Probabilities (η)					Average Widths (η)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
200	200	1	1	1	5	0.3	0.3	**0.9486**	0.9404	**0.9483**	**0.9484**	0.5904	1.5406	4.6646	3.6067	***1.5387***	1.1970
200	200	1	1	1	5	0.3	0.5	**0.9494**	**0.9472**	**0.9485**	**0.9494**	0.5842	1.0568	3.0434	2.4933	***1.0556***	1.2040
200	200	1	1	1	5	0.5	0.5	**0.9496**	0.9276	**0.9490**	**0.9496**	0.7146	3.1568	11.7079	7.5928	***3.1523***	1.4820
200	200	1	1	5	5	0.3	0.3	**0.9466**	**0.9472**	0.9423	**0.9462**	0.6306	0.3701	0.8792	0.8517	***0.3696***	0.2614
200	200	1	1	5	5	0.3	0.5	**0.9468**	**0.9556**	**0.9453**	**0.9466**	0.7130	0.2537	0.6068	0.6162	***0.2534***	0.3293
200	200	1	1	5	5	0.5	0.5	**0.9538**	**0.9518**	0.9444	**0.9536**	0.7814	0.7116	1.6077	1.6124	***0.7106***	0.3863
200	200	1	1	5	10	0.3	0.3	**0.9468**	**0.9484**	0.9417	**0.9468**	0.4988	0.3695	0.8514	0.8786	***0.3690***	0.2121
200	200	1	1	5	10	0.3	0.5	**0.9490**	**0.9522**	0.9440	**0.9490**	0.5878	0.2527	0.5898	0.6141	***0.2524***	0.2442
200	200	1	1	5	10	0.5	0.5	**0.9534**	**0.9476**	0.9395	**0.9532**	0.6806	0.7534	1.6227	1.7983	***0.7523***	0.3143
200	200	1	1	10	10	0.3	0.3	0.9446	**0.9490**	0.9355	0.9446	0.5104	0.2124	***0.5249***	0.5171	0.2121	0.1483
200	200	1	1	10	10	0.3	0.5	**0.9506**	**0.9560**	0.9383	**0.9496**	0.6702	0.1448	0.3672	0.3262	***0.1447***	0.1903
200	200	1	1	10	10	0.5	0.5	**0.9542**	**0.9480**	0.9420	**0.9538**	0.7238	0.4147	0.9154	0.9526	***0.4141***	0.2256

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 12. The coverage probabilities and average widths of the 95% confidence intervals for the ratio of variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (30, 50).

Parameters								Coverage Probabilities (η)					Average Widths (η)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
30	50	0.5	0.5	1	1	0.3	0.3	**0.9524**	**0.9480**	0.9370	**0.9522**	0.2674	0.8879	2.4463	2.1937	***0.8868***	0.4418
30	50	0.5	0.5	1	1	0.3	0.5	**0.9520**	**0.9512**	**0.9484**	**0.9520**	0.2646	0.5899	1.5313	1.3729	***0.5892***	0.5057
30	50	0.5	0.5	1	1	0.5	0.5	**0.9528**	0.9388	**0.9451**	**0.9526**	0.3222	1.3335	4.8205	3.1358	***1.3315***	0.6038
30	50	0.5	0.5	1	5	0.3	0.3	**0.9524**	0.9384	**0.9475**	**0.9518**	0.1210	1.2746	3.1763	3.1755	***1.2730***	0.3322
30	50	0.5	0.5	1	5	0.3	0.5	**0.9514**	0.9446	0.9422	**0.9506**	0.1460	0.8416	2.0529	1.8595	***0.8406***	0.3519
30	50	0.5	0.5	1	5	0.5	0.5	**0.9508**	0.9232	0.9423	**0.9504**	0.1854	1.7654	5.2181	4.0880	***1.7624***	0.4604
30	50	0.5	0.5	5	5	0.3	0.3	**0.9520**	**0.9478**	**0.9492**	**0.9516**	0.1358	0.2861	0.6569	0.6820	***0.2857***	0.0874
30	50	0.5	0.5	5	5	0.3	0.5	**0.9520**	**0.9490**	0.9424	**0.9520**	0.1776	0.1887	0.4501	0.4419	***0.1885***	0.1071
30	50	0.5	0.5	5	5	0.5	0.5	**0.9520**	0.9332	0.9429	**0.9518**	0.2138	0.4728	1.1687	1.0738	***0.4720***	0.1328
30	50	0.5	0.5	5	10	0.3	0.3	**0.9530**	0.9432	**0.9456**	**0.9524**	0.1138	0.2853	0.6388	0.6480	***0.2849***	0.0785
30	50	0.5	0.5	5	10	0.3	0.5	**0.9528**	**0.9524**	0.9397	**0.9528**	0.1486	0.1879	0.4381	0.4193	***0.1877***	0.0865
30	50	0.5	0.5	5	10	0.5	0.5	**0.9528**	0.9324	0.9384	**0.9528**	0.1838	0.4318	1.0796	0.9520	***0.4311***	0.1164
30	50	0.5	0.5	10	10	0.3	0.3	**0.9512**	**0.9450**	0.9445	**0.9508**	0.1120	0.1556	0.4023	0.3472	***0.1554***	0.0607
30	50	0.5	0.5	10	10	0.3	0.5	**0.9512**	**0.9518**	0.9351	**0.9510**	0.1608	0.1023	0.2797	0.2298	***0.1021***	0.0705
30	50	0.5	0.5	10	10	0.5	0.5	**0.9510**	0.9334	0.9366	**0.9506**	0.2002	0.2686	0.7347	0.6523	***0.2681***	0.0843
30	50	0.5	1	1	1	0.3	0.3	**0.9524**	**0.9492**	0.9416	**0.9524**	**0.9780**	0.1638	0.5335	0.3700	***0.1636***	2.5740
30	50	0.5	1	1	1	0.3	0.5	**0.9534**	**0.9496**	0.9401	**0.9530**	**0.9540**	0.1092	0.3214	0.2720	***0.1091***	3.1660
30	50	0.5	1	1	1	0.5	0.5	**0.9538**	0.9318	0.9361	**0.9534**	**0.9706**	0.2556	1.2807	0.6025	***0.2553***	3.2760
30	50	0.5	1	1	5	0.3	0.3	**0.9526**	0.9410	0.9393	**0.9526**	0.8248	0.2846	0.7236	0.6869	***0.2843***	0.5244
30	50	0.5	1	1	5	0.3	0.5	**0.9512**	**0.9450**	0.9423	**0.9512**	0.8834	0.1883	0.4645	0.4442	***0.1880***	0.6674
30	50	0.5	1	1	5	0.5	0.5	**0.9536**	0.9312	0.9401	**0.9534**	0.9324	0.4074	1.2495	0.9337	***0.4068***	0.7475
30	50	0.5	1	5	5	0.3	0.3	**0.9522**	**0.9470**	0.9365	**0.9514**	**0.9576**	0.0726	0.1719	0.1680	***0.0725***	0.3761
30	50	0.5	1	5	5	0.3	0.5	**0.9556**	**0.9454**	0.9376	**0.9554**	**0.9798**	0.0484	0.1174	0.1201	***0.0483***	0.5497
30	50	0.5	1	5	5	0.5	0.5	**0.9510**	0.9344	**0.9481**	**0.9510**	**0.9782**	0.1282	0.3274	0.2823	***0.1280***	0.5543
30	50	0.5	1	5	10	0.3	0.3	**0.9520**	**0.9478**	**0.9455**	**0.9516**	0.9066	0.0715	0.1642	0.1608	***0.0714***	0.2224
30	50	0.5	1	5	10	0.3	0.5	**0.9520**	**0.9490**	0.9444	**0.9520**	**0.9670**	0.0472	0.1125	0.1155	***0.0471***	0.3274
30	50	0.5	1	5	10	0.5	0.5	**0.9520**	0.9332	0.9374	**0.9518**	**0.9676**	0.1182	0.2922	0.2780	***0.1180***	0.3354
30	50	0.5	1	10	10	0.3	0.3	**0.9514**	**0.9460**	**0.9471**	**0.9512**	0.9358	***0.0433***	0.1117	0.1059	***0.0433***	0.2160
30	50	0.5	1	10	10	0.3	0.5	**0.9548**	**0.9504**	0.9424	**0.9544**	**0.9798**	***0.0287***	0.0776	0.0681	***0.0287***	0.3189
30	50	0.5	1	10	10	0.5	0.5	**0.9532**	0.9332	0.9367	**0.9532**	**0.9806**	0.0825	0.2150	0.1951	***0.0823***	0.3237
30	50	1	1	1	1	0.3	0.3	**0.9512**	**0.9502**	0.9398	**0.9510**	**0.9570**	1.2188	4.8395	2.6926	***1.2172***	4.6100
30	50	1	1	1	1	0.3	0.5	**0.9520**	**0.9450**	0.9426	**0.9520**	0.9004	0.8084	2.7162	1.9197	***0.8074***	5.1840
30	50	1	1	1	1	0.5	0.5	**0.9550**	0.9422	0.9369	**0.9548**	**0.9476**	1.8113	12.5550	4.1975	***1.8085***	6.1900
30	50	1	1	1	5	0.3	0.3	**0.9538**	0.9336	**0.9488**	**0.9534**	0.5938	2.2273	7.4034	5.4126	***2.2244***	3.4810
30	50	1	1	1	5	0.3	0.5	**0.9522**	0.9396	0.9434	**0.9520**	0.5998	1.4723	4.4488	3.6798	***1.4705***	3.5180
30	50	1	1	1	5	0.5	0.5	**0.9540**	0.9144	0.9438	**0.9536**	0.6810	3.0834	14.2498	6.8237	***3.0783***	4.4100
30	50	1	1	5	5	0.3	0.3	**0.9526**	**0.9482**	0.9380	**0.9524**	0.6278	0.4946	1.1204	1.2364	***0.4940***	0.6262
30	50	1	1	5	5	0.3	0.5	**0.9542**	**0.9498**	0.9449	**0.9538**	0.7084	0.3277	0.7502	0.7766	***0.3273***	0.7442
30	50	1	1	5	5	0.5	0.5	**0.9508**	0.9364	**0.9461**	**0.9506**	0.7772	0.7791	1.9882	1.8567	***0.7779***	0.9280
30	50	1	1	5	10	0.3	0.3	**0.9528**	0.9438	**0.9460**	**0.9522**	0.4934	0.5280	1.1559	1.2327	***0.5274***	0.5345
30	50	1	1	5	10	0.3	0.5	**0.9508**	**0.9510**	0.9401	**0.9508**	0.5840	0.3484	0.7775	0.8704	***0.3480***	0.5906
30	50	1	1	5	10	0.5	0.5	**0.9526**	0.9318	0.9437	**0.9526**	0.6792	0.7839	1.9213	1.8228	***0.7826***	0.7990
30	50	1	1	10	10	0.3	0.3	**0.9520**	**0.9478**	0.9426	**0.9516**	0.4980	0.2861	0.6569	0.6470	***0.2857***	0.3513
30	50	1	1	10	10	0.3	0.5	**0.9520**	**0.9490**	0.9352	**0.9520**	0.6326	0.1887	0.4501	0.4689	***0.1885***	0.4275
30	50	1	1	10	10	0.5	0.5	**0.9520**	0.9332	0.9372	**0.9518**	0.7118	0.4728	1.1687	1.1314	***0.4720***	0.5312

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 13. The coverage probabilities and average widths of the 95% confidence intervals for the ratio of variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (50, 100).

Parameters								Coverage Probabilities (η)					Average Widths (η)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
50	100	0.5	0.5	1	1	0.3	0.3	**0.9506**	**0.9490**	**0.9461**	**0.9504**	0.2638	0.9126	2.9678	2.2801	***0.9113***	0.3129
50	100	0.5	0.5	1	1	0.3	0.5	0.9438	**0.9482**	0.9442	0.9432	0.2644	0.5975	***1.7830***	1.3444	0.5968	0.3590
50	100	0.5	0.5	1	1	0.5	0.5	0.9448	**0.9482**	**0.9499**	0.9446	0.3230	0.4067	1.1437	***0.9866***	0.4063	0.4260
50	100	0.5	0.5	1	5	0.3	0.3	**0.9520**	0.9382	**0.9478**	**0.9520**	0.1270	1.1762	3.4037	2.8476	***1.1745***	0.2524
50	100	0.5	0.5	1	5	0.3	0.5	**0.9478**	0.9436	0.9436	**0.9470**	0.1406	0.7559	2.1346	1.7698	***0.7550***	0.2599
50	100	0.5	0.5	1	5	0.5	0.5	**0.9478**	**0.9490**	**0.9489**	**0.9478**	0.1928	0.5097	1.4034	1.1804	***0.5091***	0.3442
50	100	0.5	0.5	5	5	0.3	0.3	**0.9504**	0.9440	**0.9490**	**0.9502**	0.1362	0.3174	0.8586	0.7887	***0.3169***	0.0652
50	100	0.5	0.5	5	5	0.3	0.5	**0.9462**	0.9442	0.9427	**0.9458**	0.1804	0.2039	0.5885	0.4844	***0.2036***	0.0781
50	100	0.5	0.5	5	5	0.5	0.5	0.9426	**0.9478**	**0.9494**	0.9426	0.2080	0.1372	0.4079	***0.3322***	0.1371	0.0983
50	100	0.5	0.5	5	10	0.3	0.3	**0.9516**	0.9420	0.9364	**0.9514**	0.1014	0.2842	0.7926	0.6463	***0.2838***	0.0590
50	100	0.5	0.5	5	10	0.3	0.5	0.9444	**0.9450**	**0.9471**	0.9442	0.1462	0.1805	0.5447	***0.4450***	0.1803	0.0642
50	100	0.5	0.5	5	10	0.5	0.5	**0.9460**	**0.9488**	0.9390	**0.9452**	0.1904	0.1210	0.3779	0.2900	***0.1209***	0.0875
50	100	0.5	0.5	10	10	0.3	0.3	**0.9492**	0.9448	**0.9472**	**0.9486**	0.1146	0.1773	0.5534	0.4190	***0.1770***	0.0449
50	100	0.5	0.5	10	10	0.3	0.5	0.9436	**0.9472**	0.9408	0.9434	0.1582	0.1126	***0.3865***	0.2601	0.1124	0.0513
50	100	0.5	0.5	10	10	0.5	0.5	0.9444	**0.9454**	0.9416	0.9442	0.1932	0.0753	***0.2706***	0.1769	0.0752	0.0624
50	100	0.5	1	1	1	0.3	0.3	**0.9500**	0.9406	**0.9487**	**0.9498**	**0.9940**	0.1765	0.7348	0.4338	***0.1763***	1.7190
50	100	0.5	1	1	1	0.3	0.5	**0.9456**	**0.9454**	0.9395	**0.9454**	**0.9880**	0.1163	0.4080	0.2650	***0.1162***	2.1510
50	100	0.5	1	1	1	0.5	0.5	**0.9458**	**0.9452**	**0.9461**	**0.9458**	**0.9918**	0.0796	0.2533	0.1891	***0.0795***	2.1640
50	100	0.5	1	1	5	0.3	0.3	**0.9510**	0.9432	0.9368	**0.9504**	0.7814	0.2736	0.8041	0.6184	***0.2732***	0.3717
50	100	0.5	1	1	5	0.3	0.5	**0.9466**	**0.9480**	0.9416	**0.9464**	0.8852	0.1766	0.4985	0.3997	***0.1763***	0.4705
50	100	0.5	1	1	5	0.5	0.5	0.9434	**0.9510**	**0.9495**	0.9430	0.9314	0.1192	0.3264	***0.2660***	0.1191	0.5298
50	100	0.5	1	5	5	0.3	0.3	**0.9494**	0.9410	0.9367	**0.9482**	**0.9736**	0.0895	0.2393	0.2002	***0.0894***	0.2678
50	100	0.5	1	5	5	0.3	0.5	**0.9500**	**0.9456**	**0.9460**	**0.9498**	**0.9896**	0.0593	0.1628	0.1410	***0.0592***	0.3890
50	100	0.5	1	5	5	0.5	0.5	**0.9488**	0.9406	0.9442	**0.9486**	**0.9870**	0.0406	0.1127	0.0994	***0.0405***	0.3940
50	100	0.5	1	5	10	0.3	0.3	**0.9504**	0.9440	0.9395	**0.9502**	0.9160	0.0793	0.2147	0.1967	***0.0792***	0.1582
50	100	0.5	1	5	10	0.3	0.5	**0.9462**	0.9442	0.9380	**0.9458**	**0.9724**	0.0510	0.1471	0.1206	***0.0509***	0.2303
50	100	0.5	1	5	10	0.5	0.5	0.9426	**0.9478**	**0.9451**	0.9426	**0.9808**	0.0343	0.1020	***0.0775***	0.0343	0.2388
50	100	0.5	1	10	10	0.3	0.3	**0.9490**	0.9414	**0.9482**	**0.9488**	0.9412	0.0566	0.1621	0.1255	***0.0565***	0.1524
50	100	0.5	1	10	10	0.3	0.5	**0.9510**	0.9422	0.9440	**0.9508**	**0.9890**	0.0370	0.1129	0.0865	***0.0369***	0.2271
50	100	0.5	1	10	10	0.5	0.5	**0.9484**	**0.9458**	**0.9475**	**0.9484**	**0.9910**	***0.0251***	0.0790	0.0615	***0.0251***	0.2291
50	100	1	1	1	1	0.3	0.3	**0.9492**	**0.9474**	0.9419	**0.9488**	**0.9752**	1.2297	6.3208	2.7568	***1.2281***	3.2130
50	100	1	1	1	1	0.3	0.5	0.9432	**0.9478**	0.9351	0.9426	0.9366	0.8003	***3.1940***	1.8876	0.7993	3.4820
50	100	1	1	1	1	0.5	0.5	**0.9464**	**0.9492**	**0.9465**	**0.9460**	**0.9754**	0.5438	1.8654	1.2855	***0.5432***	4.1000
50	100	1	1	1	5	0.3	0.3	**0.9532**	0.9310	**0.9484**	**0.9532**	0.6020	2.0667	8.0032	4.6692	***2.0638***	2.5250
50	100	1	1	1	5	0.3	0.5	**0.9468**	0.9436	0.9443	**0.9466**	0.6042	1.3335	4.5408	2.9531	***1.3318***	2.5690
50	100	1	1	1	5	0.5	0.5	**0.9448**	0.9436	0.9437	0.9442	0.7136	***0.9007***	2.8107	2.0413	0.8996	3.2820
50	100	1	1	5	5	0.3	0.3	**0.9492**	**0.9460**	0.9413	**0.9490**	0.6144	0.5302	1.3957	1.1705	***0.5295***	0.4595
50	100	1	1	5	5	0.3	0.5	0.9434	**0.9512**	0.9402	0.9428	0.7062	0.3448	***0.9241***	0.7612	0.3444	0.5430
50	100	1	1	5	5	0.5	0.5	0.9442	**0.9498**	0.9389	0.9440	0.7660	0.2336	***0.6279***	0.5372	0.2334	0.6840
50	100	1	1	5	10	0.3	0.3	**0.9508**	**0.9450**	0.9447	**0.9498**	0.4866	0.5217	1.3589	1.2050	***0.5210***	0.4015
50	100	1	1	5	10	0.3	0.5	**0.9452**	**0.9496**	0.9360	**0.9450**	0.5596	0.3341	0.9072	0.7907	***0.3336***	0.4365
50	100	1	1	5	10	0.5	0.5	0.9446	**0.9476**	0.9414	0.9440	0.6746	0.2247	***0.6178***	0.5190	0.2244	0.5911
50	100	1	1	10	10	0.3	0.3	**0.9504**	0.9440	0.9353	**0.9502**	0.5046	0.3174	0.8586	0.7685	***0.3169***	0.2595
50	100	1	1	10	10	0.3	0.5	**0.9462**	0.9442	0.9433	**0.9458**	0.6346	0.2039	0.5885	0.4970	***0.2036***	0.3113
50	100	1	1	10	10	0.5	0.5	0.9426	**0.9478**	0.9442	0.9426	0.7202	0.1372	***0.4079***	0.3199	0.1371	0.3939

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

Table 14. The coverage probabilities and average widths of the 95% confidence intervals for the ratio of variances of the delta–IG distributions in the case of sample sizes (m_1, m_2) = (100, 200).

Parameters								Coverage Probabilities (η)					Average Widths (η)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
100	200	0.5	0.5	1	1	0.3	0.3	**0.9524**	**0.9464**	0.9366	**0.9522**	0.2720	1.2174	4.0898	2.6883	***1.2155***	0.2174
100	200	0.5	0.5	1	1	0.3	0.5	**0.9468**	**0.9472**	0.9444	**0.9462**	0.2602	0.7999	2.4267	1.8946	***0.7988***	0.2432
100	200	0.5	0.5	1	1	0.5	0.5	**0.9506**	**0.9512**	**0.9470**	**0.9502**	0.3110	0.5188	1.4930	1.2662	***0.5181***	0.2908
100	200	0.5	0.5	1	5	0.3	0.3	**0.9556**	0.9262	0.9386	**0.9554**	0.1314	1.7256	5.0527	4.1256	***1.7228***	0.1759
100	200	0.5	0.5	1	5	0.3	0.5	**0.9512**	0.9392	**0.9491**	**0.9510**	0.1508	1.1408	3.2465	2.8087	***1.1392***	0.1799
100	200	0.5	0.5	1	5	0.5	0.5	**0.9526**	**0.9472**	**0.9469**	**0.9522**	0.1956	0.7331	2.0417	1.8102	***0.7322***	0.2353
100	200	0.5	0.5	5	5	0.3	0.3	**0.9502**	0.9370	0.9350	**0.9498**	0.1386	0.4166	1.0446	1.0116	***0.4159***	0.0456
100	200	0.5	0.5	5	5	0.3	0.5	**0.9496**	**0.9462**	**0.9467**	**0.9494**	0.1812	0.2701	0.7368	0.5988	***0.2698***	0.0546
100	200	0.5	0.5	5	5	0.5	0.5	**0.9506**	0.9432	0.9360	**0.9506**	0.2168	0.1746	0.5064	0.4206	***0.1744***	0.0690
100	200	0.5	0.5	5	10	0.3	0.3	**0.9544**	0.9316	0.9432	**0.9540**	0.1144	0.4005	1.0096	0.9855	***0.3998***	0.0412
100	200	0.5	0.5	5	10	0.3	0.5	**0.9516**	0.9428	**0.9463**	**0.9510**	0.1474	0.2610	0.7240	0.6337	***0.2606***	0.0449
100	200	0.5	0.5	5	10	0.5	0.5	**0.9520**	0.9438	0.9442	**0.9514**	0.1920	0.1675	0.4982	0.3851	***0.1673***	0.0616
100	200	0.5	0.5	10	10	0.3	0.3	**0.9502**	0.9336	**0.9481**	**0.9502**	0.1132	0.2313	0.6561	0.5246	***0.2309***	0.0316
100	200	0.5	0.5	10	10	0.3	0.5	**0.9484**	**0.9466**	0.9396	**0.9482**	0.1468	0.1487	0.4769	0.3386	***0.1485***	0.0360

Table 14. *Cont.*

Parameters								Coverage Probabilities (η)					Average Widths (η)				
n_1	n_2	μ_1	μ_2	λ_1	λ_2	δ_1	δ_2	AGCI	FCI	BCI	MOVER	NA	AGCI	FCI	BCI	MOVER	NA
100	200	0.5	0.5	10	10	0.5	0.5	**0.9516**	0.9418	0.9367	**0.9510**	0.2050	0.0957	0.3336	0.2213	***0.0956***	0.0436
100	200	0.5	1	1	1	0.3	0.3	**0.9512**	**0.9498**	**0.9450**	**0.9510**	**0.9984**	0.2256	0.9519	0.5557	***0.2253***	1.1920
100	200	0.5	1	1	1	0.3	0.5	**0.9484**	**0.9496**	0.9388	**0.9478**	**0.9974**	0.1479	0.5235	0.3456	***0.1477***	1.4650
100	200	0.5	1	1	1	0.5	0.5	**0.9492**	**0.9488**	0.9376	**0.9492**	**0.9980**	0.0964	0.3087	0.2176	***0.0963***	1.4740
100	200	0.5	1	1	5	0.3	0.3	**0.9554**	0.9334	0.9381	**0.9552**	0.7746	0.3878	1.1639	0.9169	***0.3872***	0.2583
100	200	0.5	1	1	5	0.3	0.5	**0.9524**	0.9436	0.9417	**0.9524**	0.8764	0.2554	0.7335	0.6371	***0.2551***	0.3271
100	200	0.5	1	1	5	0.5	0.5	**0.9514**	**0.9464**	**0.9481**	**0.9510**	0.9210	0.1645	0.4594	0.4057	***0.1643***	0.3618
100	200	0.5	1	5	5	0.3	0.3	**0.9520**	0.9432	0.9435	**0.9518**	**0.9812**	0.1085	0.2758	0.2584	***0.1084***	0.1873
100	200	0.5	1	5	5	0.3	0.5	**0.9514**	**0.9486**	0.9360	**0.9508**	**0.9942**	0.0712	0.1901	0.1638	***0.0711***	0.2735
100	200	0.5	1	5	5	0.5	0.5	**0.9508**	**0.9468**	0.9365	**0.9502**	**0.9976**	0.0470	0.1305	0.1091	***0.0469***	0.2764
100	200	0.5	1	5	10	0.3	0.3	**0.9502**	0.9370	0.9400	**0.9498**	0.9108	0.1041	0.2612	0.2345	***0.1040***	0.1110
100	200	0.5	1	5	10	0.3	0.5	**0.9496**	**0.9462**	0.9366	**0.9494**	**0.9844**	0.0675	0.1842	0.1580	***0.0674***	0.1628
100	200	0.5	1	5	10	0.5	0.5	**0.9506**	0.9432	0.9433	**0.9506**	**0.9796**	0.0437	0.1266	0.1020	***0.0436***	0.1682
100	200	0.5	1	10	10	0.3	0.3	**0.9544**	0.9392	**0.9485**	**0.9542**	**0.9512**	0.0673	0.1828	0.1543	***0.0672***	0.1076
100	200	0.5	1	10	10	0.3	0.5	**0.9534**	**0.9452**	0.9417	**0.9534**	**0.9920**	***0.0436***	0.1302	0.1065	***0.0436***	0.1603
100	200	0.5	1	10	10	0.5	0.5	**0.9500**	0.9406	0.9367	**0.9498**	**0.9946**	***0.0287***	0.0910	0.0651	***0.0287***	0.1626
100	200	1	1	1	1	0.3	0.3	**0.9520**	0.9424	0.9398	**0.9516**	**0.9832**	1.6422	9.8489	4.1016	***1.6396***	2.1190
100	200	1	1	1	1	0.3	0.5	**0.9482**	**0.9500**	0.9369	**0.9480**	**0.9476**	1.0753	4.7944	2.6628	***1.0738***	2.3060
100	200	1	1	1	1	0.5	0.5	**0.9498**	**0.9504**	0.9365	**0.9494**	**0.9826**	0.6936	2.5718	1.7290	***0.6928***	2.6580
100	200	1	1	1	5	0.3	0.3	**0.9582**	0.9116	0.9361	**0.9580**	0.6132	2.9949	13.6144	7.3688	***2.9902***	1.6930
100	200	1	1	1	5	0.3	0.5	**0.9514**	0.9312	0.9363	**0.9512**	0.6050	1.9858	7.5414	4.9435	***1.9831***	1.7170
100	200	1	1	1	5	0.5	0.5	**0.9506**	0.9406	0.9409	**0.9506**	0.7346	1.2765	4.3296	2.9089	***1.2749***	2.1340
100	200	1	1	5	5	0.3	0.3	**0.9470**	0.9410	0.9401	**0.9470**	0.6142	0.7006	1.7571	1.5945	***0.6995***	0.3196
100	200	1	1	5	5	0.3	0.5	**0.9486**	**0.9466**	0.9413	**0.9486**	0.6902	0.4590	1.1832	1.0924	***0.4584***	0.3791
100	200	1	1	5	5	0.5	0.5	**0.9520**	**0.9458**	**0.9452**	**0.9514**	0.7672	0.2976	0.7891	0.7015	***0.2972***	0.4738
100	200	1	1	5	10	0.3	0.3	**0.9528**	0.9314	0.9362	**0.9526**	0.4986	0.7329	1.7929	1.6289	***0.7317***	0.2817
100	200	1	1	5	10	0.3	0.5	**0.9514**	**0.9456**	**0.9470**	**0.9510**	0.5654	0.4805	1.2343	1.0669	***0.4799***	0.3082
100	200	1	1	5	10	0.5	0.5	**0.9522**	**0.9470**	0.9437	**0.9514**	0.6908	0.3090	0.8249	0.7688	***0.3086***	0.4170
100	200	1	1	10	10	0.3	0.3	**0.9502**	0.9370	**0.9472**	**0.9498**	0.5102	0.4166	1.0446	0.9744	***0.4159***	0.1829
100	200	1	1	10	10	0.3	0.5	**0.9496**	**0.9462**	0.9390	**0.9494**	0.6256	0.2701	0.7368	0.6749	***0.2698***	0.2180
100	200	1	1	10	10	0.5	0.5	**0.9506**	0.9432	0.9368	**0.9506**	0.7190	0.1746	0.5064	0.3959	***0.1744***	0.2751

Note: Bold values of CP mean values close to or greater than the nominal confidence level of 0.95 (values greater than 0.945 will be rounded to 0.95). For AW, bolded, italic values indicate the narrowest average widths with CP $\geq$ 0.95.

As shown in Figure 1, coverage probabilities for the difference in variances approach the nominal level as sample sizes increase, with AGCI and MOVER exhibiting the most stable behavior across both balanced and unbalanced designs. Figure 2 indicates a monotone decrease in average widths with increasing sample size for all methods, reflecting an improved precision. The reduction is most pronounced for AGCI and MOVER, whereas FCI, BCI, and NA produce wider intervals in small samples.

For the ratio of variances, Figure 3 shows a greater variability in CPs, particularly in small and unbalanced samples, due to the increased sensitivity of ratio-based inference. Among the competing approaches, MOVER maintains coverage probabilities closest to the nominal level. Figure 4 further shows that confidence intervals for variance ratios are generally wider and contract more slowly than those for variance differences, especially under unbalanced designs.

Across almost all configurations, AGCI and MOVER achieve satisfactory coverage while producing the narrowest interval widths. When zero-inflation probabilities are equal across populations, MOVER tends to yield slightly shorter intervals, whereas AGCI performs better when these probabilities differ. Overall, AGCI and MOVER provide the most reliable performance, with MOVER showing a particular robustness in large and unbalanced sample settings.

4. Empirical Applications

In this section, we consider three real-life data sets to illustrate the practical applicability of the proposed confidence interval methods for the difference and ratio of variances of delta–inverse Gaussian (delta–IG) distributions. All data sets exhibit zero-inflated structures, containing both zero and nonzero observations. The first data set involves traffic crash counts, the second consists of wind speed measurements, and the third is drawn from insurance data. Together, these examples are included to demonstrate that the proposed methodology is not domain-specific and can be applied to a broad class of zero-inflated data

settings. In addition, an example of constructing confidence intervals for the parameters θ and η for two independent populations is provided to further illustrate the implementation of the proposed methods.

The objective of constructing confidence intervals for the difference and ratio of two variances from delta–IG populations is to assess and compare dispersion characteristics across populations in zero-inflated data analysis. Variance, as a fundamental measure of variability and the second central moment of a distribution, quantifies the extent to which observations deviate from their mean. Within the difference-based framework, confidence intervals evaluate absolute differences in variability, where the inclusion of zero indicates no statistically significant difference between variances. In contrast, the ratio-based approach provides a scale-free assessment of relative variability, with a confidence interval of one implying no significant difference. These two approaches offer complementary perspectives that are particularly informative for zero-inflated and highly skewed count data.

By applying variance-based confidence interval methods, this study contributes to improved statistical inference and uncertainty quantification for zero-inflated data analysis. Estimating confidence intervals for the difference and ratio of variances facilitates the comparative assessment of variability, supports robust modeling and interpretation, and enhances inferential reliability across a wide range of application domains involving zero-inflated count processes.

Data set 1: The data obtained from a statistical report on road traffic accident casualties published by the Road Accident Victims Protection Company Limited and made available through the Thai Road Safety Center (Thai RSC, https://www.thairsc.com (accessed on 17 December 2025)). The data set comprises monthly traffic accident death counts recorded in November 2025 for each district across Thailand's northern and southern regions. The data are given as follows:

Northern region: 1, 1, 2, 8, 3, 1, 1, 1, 2, 2, 3, 2, 6, 1, 1, 1, 2, 16, 1, 1, 2, 1, 1, 5, 3, 2, 3, 1, 1, 2, 1, 1, 5, 2, 2, 3, 1, 1, 1, 1, 6, 1, 1, 1, 1, 2, 7, 1, 1, 1, 3, 5, 1, 0 (57 times).
Southern region: 2, 3, 1, 2, 1, 5, 2, 3, 2, 1, 3, 1, 4, 1, 1, 1, 2, 1, 1, 3, 2, 2, 1, 2, 2, 1, 1, 1, 2, 1, 4, 1, 1, 2, 2, 2, 2, 3, 1, 2, 1, 2, 1, 1, 1, 1, 2, 1, 1, 1, 2, 1, 8, 1, 4, 1, 2, 1, 2, 1, 2, 1, 0 (86 times).

Data set 2: The wind speed data from the Pattaya meteorological station and the Chonburi meteorological station. The analysis focused on the average wind speed recorded at the Pattaya station and Laem Chabang station in the Chonburi Province, Thailand (Thai Meteorological Department Automatic Weather System, https://www.tmd.go.th/service/tmdData (accessed on 15 January 2026)), during the period from October to December 2023. The data are given as follows:

Pattaya: 1.0, 1.3, 1.8, 1.8, 3.4, 4.1, 5.0, 1.4, 8.3, 1.3, 0.5, 0.9, 0.9, 3.1, 3.9, 5.3, 2.8, 10.5, 0.8, 1.9, 3.6, 5.5, 4.0, 3.1, 10.3, 1.5, 1.9, 1.3, 4.9, 5.3, 1.0, 3.1, 6.0, 0.9, 1.6, 1.0, 5.6, 5.3, 3.4, 2.3, 7.6, 1.9, 0.6, 0.8, 0.9, 8.3, 5.1, 4.4, 1.8, 6.1, 2.5, 0.6, 1.1, 1.5, 9.8, 7.1, 2.8, 5.0, 5.9, 2.1, 1.3, 1.6, 7.6, 6.6, 2.4, 3.8, 1.6, 0.8, 1.9, 2.5, 1.1, 7.0, 5.3, 3.1, 3.9, 3.4, 2.6, 1.6, 5.4, 6.9, 1.8, 5.1, 3.6, 1.6, 1.0, 0 (7 times).
Laem Chabang: 3.2, 3.2, 2.9, 3.2, 4.2, 4.4, 5.0, 1.7, 3.0, 3.3, 3.0, 3.3, 4.2, 7.0, 2.9, 2.6, 2.7, 2.9, 3.3, 5.1, 7.6, 2.0, 2.6, 3.6, 2.4, 3.8, 3.4, 4.2, 4.5, 6.4, 2.9, 3.4, 2.9, 3.1, 5.6, 5.5, 3.7, 5.2, 5.6, 2.6, 4.2, 3.1, 2.6, 5.7, 5.5, 2.9, 2.4, 5.4, 3.9, 3.7, 2.7, 3.5, 6.5, 3.9, 2.8, 3.2, 4.2, 2.0, 2.9, 3.0, 7.3, 5.2, 5.7, 5.3, 3.7, 2.7, 1.9, 2.4, 2.6, 6.0, 5.6, 3.1, 4.9, 3.5, 2.7, 3.5, 3.9, 2.8, 5.1, 3.1, 4.3, 4.2, 3.5, 2.5, 2.4, 0 (7 times).

Data set 3: The insurance data from reports in 2020–2021 and 2021–2022 given by the Insurance Regulatory and Development Authority of India at https://irdai.gov.in/annual-reports (accessed on 25 January 2026). The data represent the benefit amount (in crore) of the individual death claims of life insurers pending at the start of the period for 23 insurance companies in India from the years 2020–2021 and 2021–2022. The data are given as follows:

2021–2022: 3.64, 6.70, 3.70, 5.87, 3.00, 8.78, 2.71, 167.24, 7.82, 3.95, 7.28, 0.50, 0.21, 1.48, 0.02, 101.54, 0.98, 1.02, 4.40, 0 (4 times).
2020–2021: 3.80, 1.26, 0.78, 0.65, 1.15, 2.00, 9.05, 0.31, 17.58, 43.70, 2.53, 12.14, 0.02, 0.22, 0.57, 0.58, 7.78, 0.12, 0.72, 0 (4 times)

From the data sets 1, 2, and 3 above, the histograms of these data were constructed as Figure 5, Figure 6, and Figure 7, respectively. These three data sets are strictly positive and typically right-skewed, that is, asymmetric distributional models are appropriate. Consequently, model selection in the real-data analysis is conducted using the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC), which are widely used likelihood-based criteria for comparing competing statistical models. The AIC introduced by Akaike [30] is defined as

$$AIC = -2\ln L + 2k, \tag{38}$$

while the BIC conducted by Schwarz [31] is given by

$$BIC = -2\ln L + 2k\ln(m), \tag{39}$$

respectively, where L denotes the likelihood function, k is the number of estimated parameters, and m represents the sample size. Smaller values of AIC or BIC indicate a preferable balance between model fit and complexity. In this study, these criteria are used solely for relative model comparison among candidate specifications fitted to the same data set. It is noted that AIC and BIC do not assess absolute goodness of fit but provide a principled basis for selecting among competing models under the same likelihood framework.

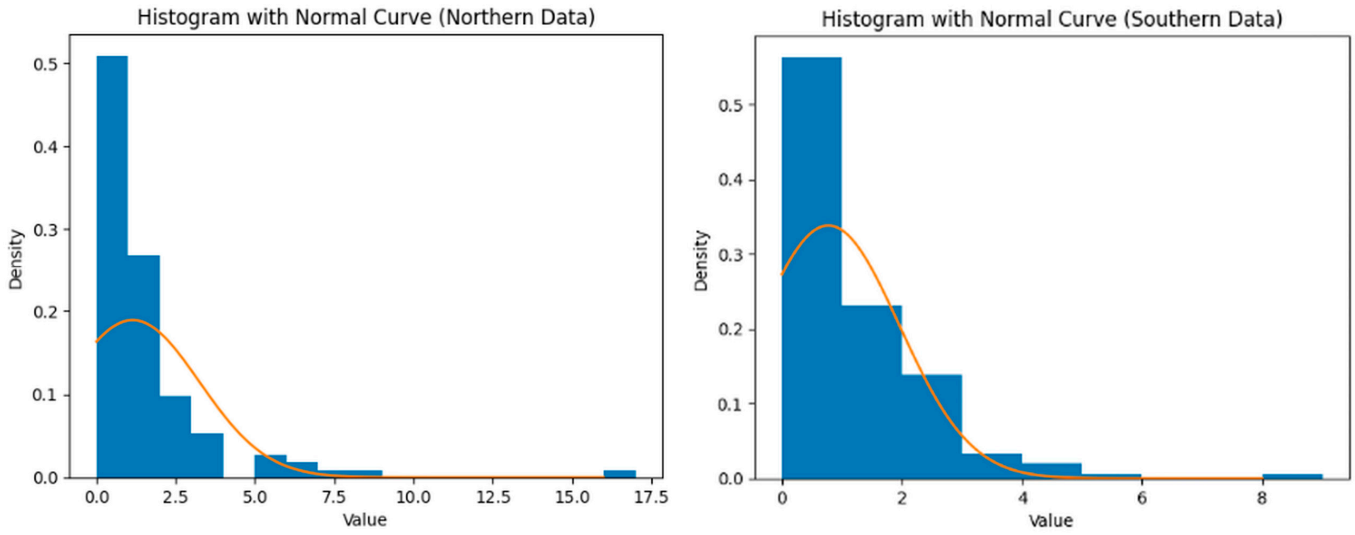


Figure 5. Histogram with fitted normal distribution curve (μ and σ estimated from the data) of data set 1 (traffic crash count data).

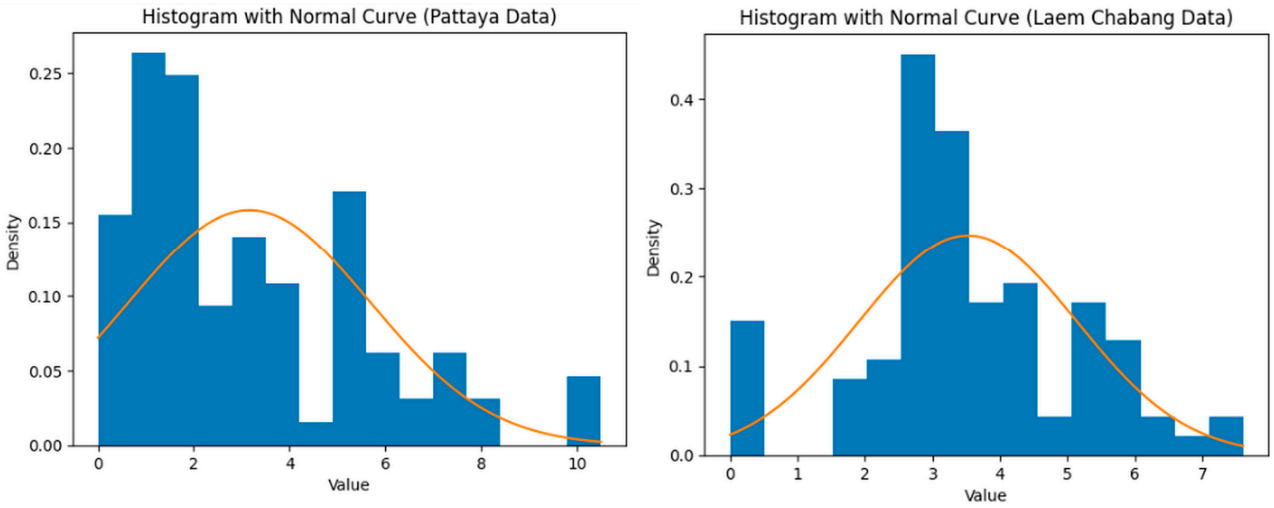


Figure 6. Histograms with fitted normal distribution curve (μ and σ estimated from the data) of data set 2 (wind speed data).

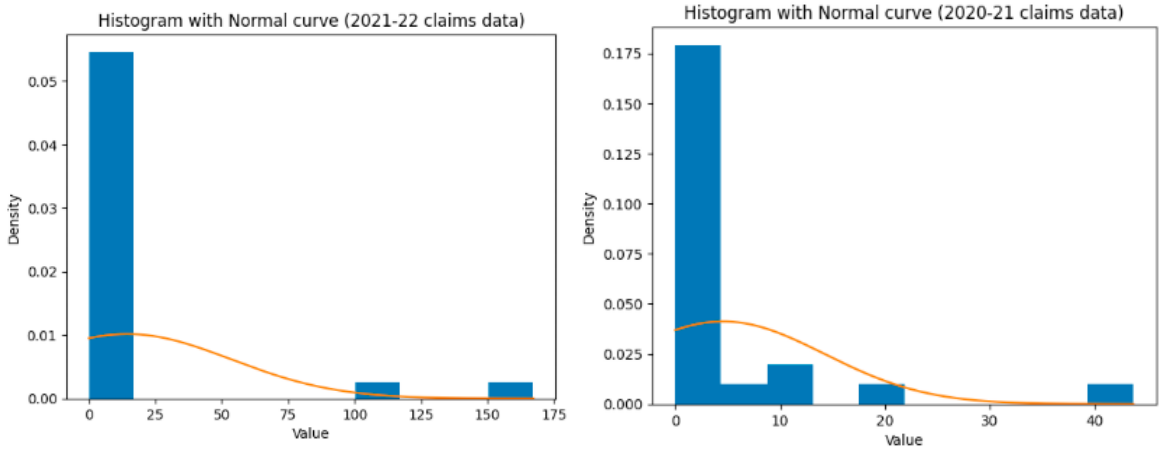


Figure 7. Histograms with fitted normal distribution curve (μ and σ estimated from the data)of data set 3 (insurance claims data).

Table 15 facilitates the identification of the most appropriate distribution by presenting the AIC and BIC values for several asymmetric models. These data sets are well described by an inverse Gaussian distribution, while the inclusion of zero counts indicates that a delta–inverse Gaussian model provides the best fit, as evidenced by its lowest AIC and BIC values.

Table 16 presents the descriptive statistics of the data sets. This study focused on assessing the performance of confidence intervals in estimating both the difference and ratio of two variances under the delta–IG distribution. All the proposed methods were utilized to establish these confidence intervals. Table 17 reports the point estimations of the difference and ratio of two variances and the 95% confidence intervals for the difference and ratio of the two variances obtained from all proposed methods. The estimated difference and ratio of variances computed from data set 1 are $\hat{\theta}$ = 1.8771 and $\hat{\eta}$ = 2.5915, respectively. The estimated difference and ratio of variances computed from data set 2 are $\hat{\theta}$ = 6.4490 and $\hat{\eta}$ = 3.5346, respectively. And the estimated difference and ratio of variances computed from data set 3 are $\hat{\theta}$ = 13,401.0 and $\hat{\eta}$ = 25.680, respectively. The results show that the MOVER method produces the narrowest interval width for both the difference and ratio of variances, followed closely by the AGCI method, whereas the FCI, BCI, and NA approaches yield wider intervals. Consistent with the evaluation based on average widths and supported

by simulation and empirical results, the MOVER and AGCI methods are considered appropriate for constructing confidence intervals for the difference and ratio of variances in delta–inverse Gaussian populations.

Table 15. AIC and BIC values for the fitting of asymmetric distributions.

Distributions	Data Set 1				Data Set 2				Data Set 3			
	Northern		Southern		Pattaya		Laem Chabang		2021–2022		2020–2021	
	AIC	BIC	AIC	BIC	AIC	BIC	AIC	BIC	AIC	BIC	AIC	BIC
Normal	261.25	265.26	214.35	218.73	397.45	402.34	291.16	296.04	199.6	201.5	146.0	147.9
Lognormal	179.33	183.35	157.61	161.99	363.01	367.90	274.12	279.00	125.8	127.7	92.65	94.54
Weibull	203.59	207.61	183.98	188.36	365.91	370.79	289.43	294.31	128.1	130.0	94.17	96.06
Gamma	197.95	201.96	170.77	175.15	363.85	368.74	277.44	282.32	132.5	134.4	96.18	98.07
Exponential	204.91	206.92	209.57	211.76	381.21	383.65	299.52	301.97	148.6	149.5	104.9	105.9
Logistic	235.76	239.78	194.56	198.94	397.93	402.82	291.81	296.69	188.6	190.5	137.5	139.4
Birnbaum–Sauders	179.83	185.86	159.04	165.61	361.07	368.40	275.63	282.96	137.7	126.1	97.03	99.87
Inverse Gaussian	177.37	181.39	156.79	161.17	360.96	365.84	271.51	276.39	124.2	134.3	91.31	93.20

Table 16. Fundamental statistics for the data.

Data	*n*	Min	Median	Mean	Max	Variance	Coefficient of Variation
Northern	112	0	0	1.1339	16	2.9797	1.5225
Southern	151	0	0	0.7616	8	1.1712	1.4209
Pattaya	92	0	2.45	3.1630	10.5	8.9933	0.9480
Laem Chabang	92	0	3.3	3.5228	7.6	2.5444	0.4528
2021–2022 claims	23	0	3	14.380	167.2	13,944	8.220
2020–2021 claims	23	0	0.72	4.5630	43.7	543.0	5.108

Table 17. The point estimations of the difference and ratio of two variances and the 95% CIs for the difference and ratio of two variances from the data sets.

Point Estimations	Methods	CI of the Difference in Two Variances		CI of the Ratio of Two Variances	
		Interval	Width	Interval	Width
Data set 1:	AGCI	(1.3540, 2.8262)	1.4722	(2.0610, 3.4610)	1.4000
$\hat{\theta} = \hat{\tau}_1 - \hat{\tau}_2 = 1.8771$	FCI	(0.4659, 4.3788)	3.9129	(1.3385, 5.1260)	3.7875
$\hat{\eta} = \hat{\tau}_1 / \hat{\tau}_2 = 2.5915$	BCI	(−2.7308, 4.4280)	7.1588	(2.0770, 6.5627)	4.4857
	MOVER	(1.3541, 2.8246)	1.4706	(2.0613, 3.4605)	1.3992
	NA	(−1.2400, 4.8840)	6.1240	(−0.6563, 5.4670)	6.1240
Data set 2:	AGCI	(4.3690, 9.7020)	5.3333	(2.5280, 4.9830)	2.4550
$\hat{\theta} = \hat{\tau}_1 - \hat{\tau}_2 = 6.4490$	FCI	(2.3720, 13.9100)	11.5400	(1.8410, 6.8150)	4.9730
$\hat{\eta} = \hat{\tau}_1 / \hat{\tau}_2 = 3.5346$	BCI	(0.8310, 14.9700)	14.1390	(0.6320, 7.3580)	6.7260
	MOVER	(4.3690, 9.6980)	5.3290	(2.5310, 4.9820)	2.4510
	NA	(−26.5200, 27.2200)	53.7400	(−25.5700, 28.1800)	53.7400
Data set 3:	AGCI	(7711.0, 31,611.0)	23,900.0	(9.4190, 66.1100)	56.690
$\hat{\theta} = \hat{\tau}_1 - \hat{\tau}_2 = 13{,}401$	FCI	(−29,173.0, 2,999, 319.0)	3,028,492.0	(0.0022, 58,848.0)	58,848.0
$\hat{\eta} = \hat{\tau}_1 / \hat{\tau}_2 = 25.680$	BCI	(−45,730.0, 3,855, 203.0)	3,900,933.0	(−41.8645, 79,325.0)	79,366.9
	MOVER	(7716.0, 31,603.0)	23,887.0	(9.4190, 65.9800)	56.560
	NA	(−268,328.0, 274,032.0)	542,361.0	(−271,155.0, 271,206.0)	542,361.0

5. Conclusions

This study developed and systematically evaluated confidence interval methodologies for the difference and ratio of two variances from independent delta–inverse Gaussian distributions. Five confidence interval approaches were examined: AGCI, FCI, BCI, MOVER, and NA. The simulation results indicated that most methods achieved coverage probabilities close to the nominal level of 0.95, with the AGCI and MOVER methods consistently

producing the narrowest average widths, reflecting a superior efficiency. The MOVER method performed particularly well when the zero-inflation probabilities were equal across populations and in large or unbalanced samples, whereas the AGCI method demonstrated a greater robustness when the zero-inflation probabilities differed. These findings provide practical guidance for selecting appropriate confidence interval procedures based on the underlying data structure.

The real-data applications are provided to complement the simulation study by illustrating the practical implementation of the proposed methods and by supporting the consistency of their empirical behavior with the simulation results. Although these illustrative real-data examples are included primarily to demonstrate practical implementation, the main contribution of this work is methodological. The empirical results from the real-data analyses are consistent with the patterns observed in the simulation studies, further supporting the practical reliability of the proposed methods. Moreover, the proposed framework can be extended to other zero-inflated distributions and variance-related functionals, providing a foundation for future research on robust inference for complex, right-skewed, and zero-inflated data.

6. Discussion

The results of this study highlight several important considerations for variance-based inference in zero-inflated and highly skewed data settings. First, the simulation findings underscore that the performance of confidence interval procedures for variance differences and ratios is highly sensitive to both the degree of zero inflation and the balance of sample sizes. In particular, methods relying heavily on asymptotic normality may exhibit unstable behavior or excessive conservatism when sample sizes are moderate or when zero-inflation probabilities differ substantially across populations. This behavior is consistent with the general findings in the literature showing that normal-based confidence intervals perform poorly under skewed distributions and are often outperformed by bootstrap or modified methods [29].

Second, the comparative performance of the examined methods suggests that no single procedure is uniformly optimal across all scenarios. The strong performance of the MOVER approach in cases with equal zero-inflation probabilities can be attributed to its effective combination of individual variance estimates, which stabilizes inference in larger or unbalanced samples. Conversely, the robustness of the AGCI method when zero-inflation probabilities differ reflects its ability to accommodate complex sampling variability without relying on restrictive distributional approximations. These observations reinforce the importance of aligning confidence interval methodology with the underlying data-generating mechanism.

Finally, while the empirical illustrations demonstrate the feasibility of the proposed methods in practice, they are not intended to provide domain-specific interpretations. Instead, they serve to emphasize that variance-based inference under zero-inflated distributions can be implemented in a straightforward manner using standard computational tools. Future methodological work may build on the present framework by exploring alternative variance-related functionals, extensions to dependent samples, or adaptations to other members of the zero-inflated distribution family.

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Abbreviations

The following abbreviations are used in this manuscript:

AGCI	Adjusted Generalized Confidence Interval
AW	Average Width
BCI	Bayesian Credible Interval
CI	Confidence Interval
CP	Coverage Probability
CV	Coefficient of Variation
delta–IG	Delta–Inverse Gaussian (Distribution)
FCI	Fiducial Confidence Interval
GCI	Generalized Confidence Interval
GPQ	Generalized Pivotal Quantity
HPD	Highest Posterior Density
IG	Inverse Gaussian (distribution)
MCMC	Markov Chain Monte Carlo
MLE	Maximum Likelihood Estimation
MOVER	Method of Variance Estimates Recovery
NA	Normal Approximation
VST	Variance-Stabilizing Transformation

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