# **Supplemental Material**

## **Supplemental Material 1: Detecting Abnormality with Kolmogorov-Smirnov Test, Shapiro-Wilk Test and Jarque-Bera Test**

The Kolmogorov Smirnov test is a very known test available in many packages such as R or SPSS. This test will compute the Kolmogorov distance, which is the maximum distance between observed distribution and theoretical distribution (i.e. normal distribution; Wilcox, 2005): . In SPSS, the observed distribution is automatically compared to a normal distribution whose mean and standard deviation are estimated by the sample. Moreover, the lillefors correction is applied by default (i.e. a correction on the critical values; Steinskog, Tjøstheim, & Kvamstø, 2007). In R, the observed distribution can be compared to normal distribution of any mean and standard deviation, that must be specified as an argument of the function. Moreover, the lillefors correction is not applied by default, implement it imply to use another function.

The Jarque-Bera test is based on skewness and kurtosis and is specifically designed to detect departures from the normal curve (Öztuna, Elhan, & Tüccar, 2006; Steinskog et al., 2007). The Shapiro-Wilk test, also specifically designed to detect departures from the normal curve (DeCarlo, 1997), is based on the correlation between the observed quantiles and normal quantiles (Ghasemi & Zahediasl, 2012; Öztuna et al., 2006). Both tests are known to be more powerful than the Kolmogorov-Smirnov test (regardless of the Lillefors correction).

### **Simulations.** Firstly, in order to estimate the Type 1 error rate for the four tests, we simulated 1,000,000 samples following a standard normal distribution (Figure A1.1), thanks to the function “rnorm” (from the package “stats”; “R: The Normal Distribution,” 2016), under five conditions, as a function of the sample size (sample sizes are respectively 10, 20, 30, 50 and 100[[1]](#footnote-1)), and we performed the four tests on simulations. Regardless of the correction, we chose to perform the Kolmogorov-Smirnov test comparing the observed distribution to a normal distribution where mean and standard deviation are estimated by the sample, as it is done in SPSS. Two steps were repeated for each condition: in a first step, the p-values of the four tests were extracted for each dataset, and in a second step, the percent of p-values under the nominal alpha risk (5%) was computed for each condition. Results are in Table A1.1.

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| *Figure A1.1*. normal curve, centered around a mean of 0, and with a standard deviation of 2. |

Secondly, in order to estimate the power, we simulated 1,000,000 samples, under 25 conditions, as a function of the sample size (sample sizes are respectively 10, 20, 30, 50 and 100[[2]](#footnote-2)), and the distributions underlying the data, and we performed the four tests on simulations. Regardless of the correction, we chose to perform the Kolmogorov-Smirnov test comparing the observed distribution to a normal distribution where mean and standard deviation are estimated by the sample, as it is done in SPSS. Two steps were repeated for each condition: in a first step, the *p*-values of the four tests were extracted for each dataset, and in a second step, the percent of *p*-values under the nominal alpha risk (5%) was computed for each condition.

In order to generate data from different distributions, we used different R commands:

### **Mixed normal distribution (mean=0, SD=1; Figure A1.2).** In order to assess the power of all tests when data are extracted from a mixed normal distribution, where P(X~N(0,2.53))= .9 and where P(X~N(0,.6325))= .1, conducting to a mixed normal distribution where mean = 0 and sd = 1, with a kurtosis of 12.80, data were generated by means of the function “rmixnorm” (from the package “bda”; Wang & Wang, 2015). Results are in Table A1.2.

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| *Figure A1.2*. distributions where mean = 0 and SD = 1, as a function of the distribution underlying the data (Mixed normal distribution vs normal) |

### **Uniform distribution (mean=0, SD=1; Figure A1.3).** In order to assess the power of all tests when data are extracted from a uniform distribution, data were generated by means of the function “runif” (from the package “stats”; “R: The Uniform Distribution,” 2016). Results are in Table A1.3.

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| *Figure A1.3*. Distributions where mean = 0 and sd = 1, as a function of the distribution underlying the data (uniform vs normal) |

### **Normal skewed distributions with positive skewness of +0.99 (mean=0, SD=1; Figure A1.4).** In order to assess the power of all tests when data are moderately skewed, data were generated by means of the function “rsnorm” (from the package “fGarch”; “R: Skew Normal Distribution,” 2017). Results are in Table A1.4.

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| *Figure A1.4*. Distributions where mean = 0 and sd = 1, as a function of the distribution underlying the data (normal skewed vs normal) |

### **Chi square distribution (mean=2, SD=1.41; Figure A1.5).** In order to assess the power of all tests when data are highly skewed, data were generated by means of the functions “rchisq” (“R: The (non-central) Chi-Squared Distribution,” 2016). Results are in Table A1.5.

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| *Figure A1.5*. Distributions where mean = 1 and sd = 1.41, as a function of the distribution underlying the data (chi square vs normal) |

### **Type 1 error rate, as a function of the sample size.** When the lillefors correction is not applied, the type 1 error rate of the Kolmogorov-Smirnov test is very close to 0, meaning that the Kolmogorov-Smirnov test will reject the null hypothesis less than 1%, regardless of the sample size, meaning that the test is too conservative. The JB is also a little too conservative. On the other side, when the lillefors correction is applied, the test has a good type 1 error rate control, in the same way that the SW test.

### **Power, as a Function of the Sample Size and Distribution Underlying the Data**

**Mixed normal distribution.** When the data follow a mixed normal distribution, the power of the Kolmogorov-Smirnov test without lillefors correction barely achieves 1% when there are 100 subjects in the sample, meaning that the test will practically never detect any departures from the normal distribution. All other tests are more powerful. With very small sample sizes (i.e. ), the most powerful test is the SW test. With at least 30 subjects per groups, the JB test is a little more powerful than the SW test (Table A1.3). However, for both test, 100 subjects are required to detect normality violations with a power of 95%, meaning that all tests are not powerful enough with small sample sizes.

**Uniform distribution.** When the data are uniformly distributed, the power of the Kolmogorov-Smirnov test without lillefors correction barely achieves 1% when there are 100 subjects in the sample, meaning that the test will practically never detect any departures from the normal distribution. In the same way, the JB test will practically never detect that distributions are not normal, except with big samples sizes (i.e. ni=100), where the test is very more powerful than Kolmogorov-Smirnov test (Table A1.3). While the Kolmogorov-Smirnov test with lillefors correction will more often detect departures from the normal assumption than both pre-mentioned tests, the SW test appear to be the best alternative, in terms of power (Table A1.3). However, even the SW test requires 100 subjects per group in order to detect the normality violations with a power of 95%, meaning that the test is not powerful enough for small sample sizes.

**Right skewed normal distribution.** When the data follow a normal skewed distribution (i.e. has a moderate skewness; skewness = 1), the power of the Kolmogorov-Smirnov test without lillefors achieves 1% when there are 30 subjects in the sample. It increases to 0.03 when there are 50 subjects, and to 0.16 when there are 100 subjects. All other solutions are more powerful, but the SW test appears to be the best solution, regardless of the sample size (Table A1.4). However, even the SW test requires 50 subjects per group in order to detect the normality violations with a power of 95%, meaning that the test is not powerful enough for small sample sizes.

**Chi-square distribution.** With moderate to big sample sizes (i.e. ), when the data follow a chi square distribution (i.e. when data are highly skewed), all tests will almost always detect the departure from the normal assumption. It is already true with 30 subjects in the sample, except with the Kolmogorov-Smirnov test without lillefors correction. With small sample sizes (), the SW is always more powerful then Kolmogorov-Smirnov test with correction and JB test (Table A1.5). Even with very small sample size, the test is very powerful.

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| Table A1.1  *Real alpha risk, when nominal alpha risk = 5%, and distributions are normal* | | | | |
|  | **Test** | | | |
| n | **Kolmogorov-Smirnov**  **(no correction)** | **Kolmogorov-Smirnov**  **(lillefors correction)** | **Shapiro-Wilk** | **Jarque-Bera** |
| 10 | < 0.01 | 0.05 | 0.05 | 0.01 |
| 20 | < 0.01 | 0.05 | 0.05 | 0.02 |
| 30 | < 0.01 | 0.05 | 0.05 | 0.03 |
| 50 | < 0.01 | 0.05 | 0.05 | 0.04 |
| 100 | < 0.01 | 0.05 | 0.05 | 0.04 |

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| Table A1.2  *Real alpha risk, when nominal alpha risk = 5%, and distributions are mixed normal* | | | | |
|  | **Test** | | | |
| n | **Kolmogorov-Smirnov**  **(no correction)** | **Kolmogorov-Smirnov**  **(lillefors correction)** | **Shapiro-Wilk** | **Jarque-Bera** |
| 10 | < 0.01 | 0.19 | 0.23 | 0.14 |
| 20 | 0.03 | 0.32 | 0.44 | 0.42 |
| 30 | 0.06 | 0.41 | 0.59 | 0.60 |
| 50 | 0.13 | 0.56 | 0.77 | 0.80 |
| 100 | 0.30 | 0.80 | 0.95 | 0.96 |

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| Table A1.3  *Real alpha risk, when nominal alpha risk = 5%, and distributions are uniform* | | | | |
|  | **Test** | | | |
| n | **Kolmogorov-Smirnov**  **(no correction)** | **Kolmogorov-Smirnov**  **(lillefors correction)** | **Shapiro-Wilk** | **Jarque-Bera** |
| 10 | < 0.01 | 0.06 | 0.08 | < 0.01 |
| 20 | < 0.01 | 0.10 | 0.20 | < 0.01 |
| 30 | < 0.01 | 0.14 | 0.38 | < 0.01 |
| 50 | < 0.01 | 0.26 | 0.75 | < 0.01 |
| 100 | 0.01 | 0.59 | 1 | 0.56 |

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| Table A1.4  *Real alpha risk, when nominal alpha risk = 5%, and distributions are normal skewed* | | | | |
|  | **Test** | | | |
| n | **Kolmogorov-Smirnov**  **(no correction)** | **Kolmogorov-Smirnov**  **(lillefors correction)** | **Shapiro-Wilk** | **Jarque-Bera** |
| 10 | < 0.01 | 0.13 | 0.19 | 0.04 |
| 20 | < 0.01 | 0.23 | 0.44 | 0.16 |
| 30 | 0.01 | 0.35 | 0.68 | 0.28 |
| 50 | 0.03 | 0.56 | 0.93 | 0.54 |
| 100 | 0.16 | 0.91 | 1 | 0.96 |

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| Table A1.5  *Real alpha risk, when nominal alpha risk = 5%, and distributions are normal skewed* | | | | |
|  | **Test** | | | |
| n | **Kolmogorov-Smirnov**  **(no correction)** | **Kolmogorov-Smirnov**  **(lillefors correction)** | **Shapiro-Wilk** | **Jarque-Bera** |
| 10 | 0.11 | 0.80 | 0.93 | 0.44 |
| 20 | 0.61 | 0.99 | 1.00 | 0.90 |
| 30 | 0.94 | 1.00 | 1.00 | 0.99 |
| 50 | 1.00 | 1.00 | 1.00 | 1.00 |
| 100 | 1.00 | 1.00 | 1.00 | 1.00 |

## **Supplemental Material 2: Sampling Distribution of the Mean and Sampling Distribution of the SD**

### **Sampling distribution of the mean (SDM).**

To use a test based on mean, it is expected that the sampling distribution of sample means () follows a normal distribution. When data are extracted from normal distribution, it is always true. When data are extracted from other distributions, it is only true when sample sizes are large. In order to show it, for each simulation, we computed the mean, SD, skewness and kurtosis of the sampling distribution of .

For each kind of distribution, the mean and SD of the sampling distribution of is consistent with our expectations. It is indeed centered around the population mean (=µ), because the sample mean is an unbiased estimator of the population mean. Moreover, for each kind of distributions, the standard deviation of the sampling distribution of equals .

On the other side, the skewness and kurtosis of the sampling distribution of depends on the distribution underlying the data when sample sizes are small. Skewnesses are presented in Table A2.1. Kurtosises are presented in Table A2.2.

As shown in table A2.1, when the data are symmetric (normal, uniform, double exponential and mixed normal distributions), the skewness of the sampling distribution of means equals 0. When the data has are right-skewed, the skewness of the sampling distribution of is positive and finally, when the data are left skewed, the skewness of the sampling distribution of is negative. Moreover, when the data have heavier tails than the normal distribution (such as when data are extracted from a double exponential, mixed normal or chi-square distribution), the kurtosis of the sampling distribution of means is above 3.

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| Table A2.1  *Skewness of the sampling distribution of , as a function of the distribution underlying the data* | | | | | | | | |
|  |  | | **Distribution underlying the data** | | | |  |  |
| **n** | **Normal** | **Double**  **exponential** | | **Mixed normal** | **Uniform** | **Normal**  **right-skewed** | **Normal**  **left-skewed** | **Chi-square** |
| **10** | 0 | 0 | |  | 0 | [.31, .32] | [-.32, -.31] | / |
| **20** | [-.01,0] | [-.01, .01] | |  | 0 | [.22, .23] | [-.22] | [.44, .45] |
| **30** | [0,.01] | [-.01, .01] | |  | [0,.01] | [.18, .19] | [-.18] | [.36, .37] |
| **40** | [-.01,0] | [-.01, .01] | |  | 0 | [.15, .16] | [-.15, -.16] | [.31, .32] |
| **50** | [-.01, .01] | [-.01, .01] | |  | 0 | [.14, .15] | [-.14] | [.28, .29] |
| **100** | 0 | [-.01, .01] | |  | [-.01,0] | [.09, .10] | [-.10] | [.19, .20] |
| **150** | 0 | [-.01, 0] | |  | 0 | [.08, .09] | [-.09, -.08] | / |
| **200** | 0 | 0 | |  | 0 | [.07] | [-.07] | / |
| *Note*. As different simulations were made to estimate the skewness of each condition, when simulations resulted in different estimation, due to the imprecision of estimation, lower and upper bound of estimations are presented in [ ]. When no simulations were made to estimate the skewness of one condition, “ / ” is written, instead of values.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Table A2.2  *Kurtosis of the sampling distribution of , as a function of the distribution underlying the data* | | | | | | | | | |  |  | | **Distribution underlying the data** | | | |  |  | | **N** | **Normal** | **Double**  **Exponential** | | **Mixed normal** | **Uniform** | **Normal**  **right-skewed** | **Normal**  **left-skewed** | **Chi-square** | | **10** | 3 | [3.29,3.31] | |  | [2.88] | [3.08,3.1] | [3.07,3.09] | / | | **20** | [2.99,3.01] | [3.14,3.16] | |  | [2.93,2.95] | [3.02,3.05] | [3.04,3.05] | [3.28,3.31] | | **30** | [2.99,3.01] | [3.09,3.11] | |  | [2.95,2.97] | [3.02,3.04] | [3.02,3.04] | [3.19,3.22] | | **40** | [2.99,3] | [3.06,3.1] | |  | [2.96,2.98] | [3,3.03] | [3.02,3.03] | [3.14,3.16] | | **50** | [2.99,3.01] | [3.05,3.07] | |  | [2.97,2.99] | [3.01,3.03] | [3.01,3.03] | [3.10,3.14] | | **100** | [2.99,3.01] | [3.02,3.04] | |  | [2.98,3] | [3,3.02] | [3,3.02] | [3.05,3.08] | | **150** | [3,3.01] | [3.02,3.04] | |  | [2.99,3] | [3,3.01] | [3,3.01] | / | | **200** | 3 | [3.01,3.02] | |  | [2.99,3] | [3,3.02] | [3,3.01] | / | | *Note*. As different simulations were made to estimate the kurtosis of each condition, when simulations resulted in different estimation, due to the imprecision of estimation, lower and upper bound of estimations are presented in [ ]. When no simulations were made to estimate the skewness of one condition, “ / ” is written, instead of values. | | | | | | | | | | | | | | | | | |

### **Sampling distribution of the variance (SDV).**

To use a test based on means, it is expected that the sampling distribution of the sample variances (= is centered around the population variance. Indeed, S² is an unbiased estimator of the population variance. It is computed as follows:

In order to show it, for each simulation, we computed the mean of the sampling distribution of S². For each kind of distribution, the mean of the sampling distribution of S² is consistent with our expectations.

It is also expected that the variance has a linear relation with the chi-square distribution with n-1 degrees of freedom: When data are extracted from normal distribution, it is always true. When data are extracted from other distributions, it is only true when sample sizes are large. As an illustration, when sample sizes equal 20, for each kind of distributions underlying the data, this chi-square distribution is compared with the sampling distribution of S², and results are shown in Figures A2.1 to A2.6.

### **Relation between and the chi-square distribution, with n-1 degrees of freedom when the distribution underlying the data is normal.** As shown in Figure A2.1, perfectly follows a chi-square distribution with n-1 degrees of freedom.

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| *Figure A2.1.* Sampling distribution of when a sample of 20 subjects is extracted from a normal distribution whose mean is 0 and sd is 1. |

### **Relation between and the chi-square distribution, with n-1 degrees of freedom when the distribution underlying the data is not normal.** When the distribution underlying the data is not normal, the sampling distribution of does not follow a chi square distribution with n-1 degrees of freedom anymore. It deviates from the chi square distribution in a way that depends on the distribution underlying the data, as shown in Figures A2.2 to A2.6.

### In all these Figures, vertical red line illustrated the mean of . It is the value of the distribution when S² exactly equals the population variance (i.e. the population variance is perfectly estimated by the sample). Left this line, the sample variance is an underestimation of the population variance. Right this line, the sample variance is an overestimation of the population variance.

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| *Figure A2.2.* Sampling distribution of when a sample of 20 subjects is extracted from a double exponential distribution whose mean is 0 and sd is 2. |

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| *Figure A2.3.* Sampling distribution of when a sample of 20 subjects is extracted from a mixed normal distribution whose mean is 0 and sd is 2. |

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| *Figure A2.4.* Sampling distribution of when a sample of 20 subjects is extracted from a right skewed normal distribution whose mean is 0 and sd is 2. |

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| *Figure A2.5.* Sampling distribution of when a sample of 20 subjects is extracted from a left skewed normal distribution whose mean is 0 and sd is 2. |

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| *Figure A2.6.* Sampling distribution of when a sample of 20 subjects is extracted from a chi-square distribution whose mean and standard deviation are 2. |

As shown in Table A2.3, for all these distributions, the probability of under-estimation is higher than expected (and therefore, the probability of over-estimation is lower than expected). It could explain the gain in power when distributions are not normal.

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| Table A2.3  *Probability of under-estimation and of over-estimation of the population variance, as a function of the distribution underlying the data.* | | |
|  | **Probability of false estimation of the population variance** | |
| Distribution | **under-estimation** | **over-estimation** |
| Normal | .54 | .46 |
| Double exponential | .59 | .41 |
| Mixed normal | .64 | .36 |
| Normal right skewed | .56 | .44 |
| Normal left skewed | .56 | .44 |
| Chi-square | .61 | .39 |

## **Supplemental Material 3: Type 1 error rate of the *F*-test, *W*-test and *F\**-test**

Assuming a Type 1 error rate of 5% under the null, a test can yield either a significant result (*p*-value < 5%; or a “false positive” -FP) or a non-significant result (*p*-value > 5%; or a “true negative”-TN).

The alpha risk is the relative frequency of effects detected as significant, under the null:

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In order to estimate the Type 1 error rate for the *F*-test and 2 well known alternatives when population variances are unequal (*W*-test and *F\**-test, both available on SPSS), we simulated 1,000,000 datasets of k samples (where k is ranging from 2 to 5) under different conditions. There were 8 blocks of simulations each of them generated under 80 conditions (yielding 4\*8\*80,000,000 simulations in total).

Two steps were repeated for each condition: in a first step, the *p*-values of the three tests were extracted for each dataset, and in a second step, the percent of *p*-values under the nominal alpha risk (5%) was computed for each condition.

In the first 7 blocks, in each condition, k-1 samples were generated from a population where and sample sizes ( were 20,30,40,50 or 100. The standard deviation and the sample size of the last sample was a function of the sample sizes ratio (n-ratio = ; ranging from 0.5 to 2 in steps of 0.5) and the SDR (respectively 0.5,1,2 or 4). The set of simulations was repeated seven times, varying the distributions underlying the data. We used R commands to generate data from different distributions:

* **k normal distributions** (Figure A3.1): In order to assess the Type 1 error rate of the different tests under the assumption of normality, data were generated by means of the function “rnorm” (from the package “stats”; “R: The Normal Distribution,” 2016) . Results are in Table A3.1a and A3.1b.
* **k double exponential distributions** (Figure A3.2): In order to assess the impact of high kurtosis on the Type 1 error rate of all tests, data were generated by means of the function “rdoublex” (from the package “smoothmest”; "R: The double exponential (Laplace) distribution," 2012). Results are in Table A3.2a and A3.2b.
* **k mixed normal distributions** (Figure A3.3): In order to assess the impact of extremely high kurtosis on the Type 1 error rate of all tests, regardless of variance, data were generated by means of the function “rmixnorm” (from the package “bda”; Wang & Wang, 2015). Results are in Table A3.3a and A3.3b.
* **k normal right skewed distributions** (Figure A3.4): In order to assess the impact of moderate skewness on the Type 1 error rate, data were generated by means of the function “rsnorm” (from the package “fGarch”; “R: Skew Normal Distribution,” 2017). The normal skewed distribution was chosen because it is the only skewed distribution where the standard deviation ratio can vary without having an impact on skewness. Results are in Table A3.4a and A3.4b.
* **k-1 normal left skewed distributions** (Figure A3.4) **and 1 normal right skewed distribution** (Figure A3.5): In order to assess the impact of unequal shapes, in terms of skewness, on the Type 1 error rate, when data have moderate skewness, data were generated by means of the functions “rsnorm” (from the package “fGarch”; “R: Skew Normal Distribution,” 2017). Results are in Table A3.5a and A3.5b.
* **k-1 chi square distributions with two degrees of freedom** (See Figure A3.6)**, and one normal right skewed distribution** (Figure A3.4): In order to assess the impact of high asymetry on the Type 1 error rate, k-1 distributions were generated by means of the functions “rchisq” (“R: The (non-central) Chi-Squared Distribution,” 2016; see Figures A3.6). Because the chi square is non-negative, it is not possible to generate chi-square where = 1, 4 or 8 and µi is the same than the chi-square with two degrees of freedom. However, we wanted to assess the impact of different SDR on Type 1 error rate. For these reasons, the last distribution was generated by means of “rsnorm” in order to follow a normal skewed distribution with positive skewness of +0.99 and mean = 2 (from the package “fGarch”; “R: Skew Normal Distribution,” 2017). Results are in Table A3.6a and A3.6b.
* **k-1 chi square distributions with two degrees of freedom** (See Figure A3.6)**, and one normal left skewed distribution** (Figure A3.5): In order to assess the impact of unequal shapes, in terms of skewness, on Type 1 error rate when distributions have extreme skewness, k-1 distributions were generated by means of the functions “rchisq” (“R: The (non-central) Chi-Squared Distribution,” 2016). The last distribution was generated by means of “rsnorm” in order to follow a normal right skewed distribution with a mean of 2 (from the package “fGarch”; “R: Skew Normal Distribution,” 2017). Results are in Table A3.7a and A3.7b.

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| **Figure A3.1**: centered normal probability density function, as a function of . |

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| **Figure A3.2**: centered double exponential probability density function, as a function of . |

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| **Figure A3.3**: centered mixed normal probability density function, as a function of . |

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| **Figure A3.4**: centered normal right skewed probability density function, as a function of .   |  | | --- | |  | | **Figure A3.5**: centered normal left skewed probability density function, as a function of . |  |  | | --- | |  | | **Figure A3.6**: chi-square with 2 degrees of freedom probability density function. | |

There is commonly a confusion between kurtosis and variance (DeCarlo, 1997). One reason is that the standard scale parameter of the double exponential distribution is which is not equal to the standard deviation: β = . In order to show the impact of kurtosis on Type 1 error rate, independently of the variance, a last set of simulations was created and in each condition, k-1 samples were generated from a double exponential distribution where β were 2 (i.e. j2.82) and sample sizes ( were 20,30,40,50 or 100. The scale parameter β and the sample size of the last group was a function of the sample sizes ratio (n-ratio = ; ranging from 0.5 to 2 in steps of 0.5) and the SDR (respectively 0.5,1,2 or 4). Results are in Table A3.8a and A3.8b.

**Results of the *F*-test.** When both assumptions of homoscedasticity and normality are met, the Type 1 error control is very close to the nominal .05, whatever the sample sizes, the number of groups to compare, and whether designs are balanced (i.e. the sample sizes are equal between groups) or not, which is conform to our expectations.

However, consistently with research conducted by Minitab statisticians available at <http://support.minitab.com/en-us/minitab/17/Assistant_One_Way_ANOVA.pdf>, simulations show that the Type 1 error rate for the *F*-test can differ noticeably from the nominal Type 1 error rate (i.e., 5%) when the groups have different variances,even with big sample sizes (i.e. when ni=100). In light of the definition of Bradley (1978), one can consider the alpha risk “sufficiently close” to the nominal alpha risk if its value falls in the interval [0.025; 0.075] (Hayes & Cai, 2007). In the tables presented below, anytime the Type 1 error rate falls outside of this interval, we have added an “\*” next to the value. Considering this norm, one can observe that when there is a positive correlation between sample size and standard deviation, the test is often too conservative and when there is a negative correlation between sample size and standard deviation, the test is often too liberal. Consistently with what we observed in a previous paper (see Delacre, Lakens, & Leys, 2017), when there are only two groups to compare, the test is robust against heteroscedasticity when sample sizes are equal between groups (and the bigger is the sample size, the truest it is). However, when there are more than two groups to compare, heteroscedasticity is problematic even when sample sizes are equal between groups. In this case, the test becomes too liberal.

The impact of normality violations on Type 1 error rate is smaller than the impact of homoscedasticity violations (Lix, Keselman, & Keselman, 1996). When the homogeneity assumption is met, the test is robust against normality violations, except when there are highly skewed distributions with big differences in terms of skewness between groups (see Table A3.7a and A3.7b). When the skewness is moderate (see Table A3.3a, A3.3b, A3.4a and A3.4b) or when the skewness has the same valence between groups (see Table A3.5a and A3.5b), with equal variance between groups, the Type 1 error rate is close to the nominal 5%.

However, when the homogeneity assumption is not met, while the impact of heavier tailed distributions on Type 1 error rate remains marginal (see Table A3.2a and A3.2b), the test becomes more liberal when distributions are skewed (even with moderate skewness or when the skewness has the same valence between groups). It is consistent with other studies showing that tests based on means are more affected by skewness than by kurtosis (DeCarlo, 1997).

Finally, when the number of groups increases, the test becomes more liberal. It improves the test when there is a positive correlation between n and sd (because the Type 1 error rate increases and it is closer to the nominal 5%), however, it is problematic when there is either negative correlation between n and sd, or heteroscedasticity with balanced designs.

**Results of the *F\**-test.** As well as the *F*-test, when the assumption of homoscedasticity and normality are met, the *F\**-test has a good Type 1 error control, regardless of the sample sizes, the number of groups and of whether sample sizes are equal or not.

Under the normality assumption, the test is robust against homoscedasticity assumption when there are only two groups to compare, which is not surprising since the *F\**-test is identical to the *W*-test when there are only two groups. However, when the number of groups increases, the test is affected by violations of the assumption of equal variances between groups (although it is less than the *F*-test, by construction). Most of the time, the test becomes more and more liberal when k increases, even with SDR=2. When SDR = 4, the Type 1 error rate is often very close to .075 when there are three groups to compare, and exceeds .075 when there are more than three groups[[3]](#footnote-3).

Under the homoscedasticity assumption, when sample sizes are small, the test becomes more liberal when there are big differences between groups, in terms of skewness (see Tables A3.5 and A3.7).

Finally, when neither the assumption of homoscedasticity nor the assumption of normality are met, the test becomes even more liberal when distributions are skewed, whatever the extent of which skewness if far from 0, and whatever the valence of skewness (See Tables A3.4, A3.5, A3.6 and A3.7). Moreover, one observed that it is true even with balanced designs, contrary to the statements of Lix, Keselman, & Keselman (1996). In conclusion, we do not recommend the use of the *F\**-test as a default strategy.

**Results of the *W*-test[[4]](#footnote-4).** As well as the *F*-test and *F\**-test, when the assumption of homoscedasticity and normality are met, the *W*-test has a good Type 1 error control, regardless of the number of groups and of whether sample sizes are equal or not.

Contrary to the *F*-test and *F\**-test, the *W*-test is totally immune to the violations of the assumption of equal variances, as long as the normality assumption is met. However, the test is more sensitive to the normality violations than both the *F*-test and *F\**-test. Even under the homoscedasticity assumption, one can observe an effect of skewness: when skewness moves away from 0, the test becomes more liberal. When there are three groups to compare, when all distributions have a skewness of equal sign, the test is quite robust when all designs are balanced (meaning that all sample sizes are equal; see Tables A3.4 and A3.6). However, when distributions have skewness of opposite sign (any distributions with positive skewness, other distributions with negative skewness), the test becomes too liberal, even with balanced designs (see Tables A3.5 and A3.7). When the number of groups increases, the test is more and more liberal. It remains robust only with moderate skewness of similar valence between groups.

Moreover, it seems to have an interaction effect between violations of both normality and heteroscedasticity: when there is heteroscedasticity, the test becomes even more liberal with skewed distributions, particularly when there is a negative correlation between the sample sizes and standard deviations, and when there is high skewness with different sign of skewness between groups. The interaction effect between skewness and heteroscedasticity is consistent with the statement of Lix, Keselman, & Keselman (1996) about the Alexander-Govern and the James second order tests.

When variances are unequal, it makes no sense to compare directly the *F*-test with the *W*-test and *F\**-test, because the *F*-test is not valid, as previously explained. However, when there are equal variances between groups, one can observe that:

1. the *W*-test is a little more affected by heavy tailed distributions, in terms of Type 1 error rate, than the *F*-test (meaning that it becomes more conservative with heavy tailed distributions than the *F*-test)
2. the test become too liberal with high skewness (such as with chi square distributions with two degrees of freedom; See Table A3.6a, A3.6b, A3.7a and A3.7b), while the *F*-test has a good Type 1 error control in these situations.

These two observations are more and more true when the number of groups increases (i.e. when the number of groups increases, the test becomes even more conservative with heavy tailed distributions and even more liberal with moderate/high skewness; for example, the test is robust to moderate asymmetry when there are 3 groups to compare, however it is not when the number of groups increases), even if sample sizes are big (more than 50 subjects per group).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table A3.1a  *Real alpha risk, when nominal alpha risk = 5%, two groups are compared and samples are extracted from normal distributions.* | | | | | |
|  |  |  | **Test** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | Welch | B-F |
| **0.5** | **20** | **0.5** | 0,019\* | 0,049 | 0,049 |
| **1** | **20** | **0.5** | 0,050 | 0,050 | 0,050 |
| **2** | **20** | **0.5** | 0,114\* | 0,051 | 0,051 |
| **4** | **20** | **0.5** | 0,162\* | 0,051 | 0,051 |
| **0.5** | **20** | **1** | 0,052 | 0,050 | 0,050 |
| **1** | **20** | **1** | 0,050 | 0,050 | 0,050 |
| **2** | **20** | **1** | 0,052 | 0,050 | 0,050 |
| **4** | **20** | **1** | 0,056 | 0,051 | 0,051 |
| **0.5** | **20** | **1.5** | 0,085\* | 0,051 | 0,051 |
| **1** | **20** | **1.5** | 0,051 | 0,050 | 0,050 |
| **2** | **20** | **1.5** | 0,029 | 0,050 | 0,050 |
| **4** | **20** | **1.5** | 0,022\* | 0,050 | 0,050 |
| **0.5** | **20** | **2** | 0,112\* | 0,050 | 0,050 |
| **1** | **20** | **2** | 0,050 | 0,050 | 0,050 |
| **2** | **20** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **20** | **2** | 0,009\* | 0,050 | 0,050 |
| **0.5** | **30** | **0.5** | 0,018\* | 0,049 | 0,049 |
| **1** | **30** | **0.5** | 0,050 | 0,050 | 0,050 |
| **2** | **30** | **0.5** | 0,113\* | 0,051 | 0,051 |
| **4** | **30** | **0.5** | 0,158\* | 0,051 | 0,051 |
| **0.5** | **30** | **1** | 0,052 | 0,050 | 0,050 |
| **1** | **30** | **1** | 0,050 | 0,050 | 0,050 |
| **2** | **30** | **1** | 0,052 | 0,050 | 0,050 |
| **4** | **30** | **1** | 0,054 | 0,050 | 0,050 |
| **0.5** | **30** | **1.5** | 0,084\* | 0,050 | 0,050 |
| **1** | **30** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **30** | **1.5** | 0,028 | 0,050 | 0,050 |
| **4** | **30** | **1.5** | 0,021\* | 0,050 | 0,050 |
| **0.5** | **30** | **2** | 0,111\* | 0,050 | 0,050 |
| **1** | **30** | **2** | 0,050 | 0,050 | 0,050 |
| **2** | **30** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **30** | **2** | 0,009\* | 0,050 | 0,050 |
| **0.5** | **40** | **0.5** | 0,018\* | 0,050 | 0,050 |
| **1** | **40** | **0.5** | 0,050 | 0,050 | 0,050 |
| **2** | **40** | **0.5** | 0,112\* | 0,050 | 0,050 |
| **4** | **40** | **0.5** | 0,155\* | 0,050 | 0,050 |
| **0.5** | **40** | **1** | 0,051 | 0,050 | 0,050 |
| **1** | **40** | **1** | 0,050 | 0,050 | 0,050 |
| **2** | **40** | **1** | 0,051 | 0,050 | 0,050 |
| **4** | **40** | **1** | 0,053 | 0,050 | 0,050 |
| **0.5** | **40** | **1.5** | 0,084\* | 0,050 | 0,050 |
| **1** | **40** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **40** | **1.5** | 0,028 | 0,050 | 0,050 |
| **4** | **40** | **1.5** | 0,020\* | 0,050 | 0,050 |
| **0.5** | **40** | **2** | 0,111\* | 0,050 | 0,050 |
| **1** | **40** | **2** | 0,050 | 0,050 | 0,050 |
| **2** | **40** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **40** | **2** | 0,009\* | 0,050 | 0,050 |
| **0.5** | **50** | **0.5** | 0,018\* | 0,050 | 0,050 |
| **1** | **50** | **0.5** | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **0.5** | 0,112\* | 0,050 | 0,050 |
| **4** | **50** | **0.5** | 0,153\* | 0,050 | 0,050 |
| **0.5** | **50** | **1** | 0,051 | 0,050 | 0,050 |
| **1** | **50** | **1** | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **1** | 0,051 | 0,050 | 0,050 |
| **4** | **50** | **1** | 0,052 | 0,050 | 0,050 |
| **0.5** | **50** | **1.5** | 0,084\* | 0,050 | 0,050 |
| **1** | **50** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **1.5** | 0,028 | 0,050 | 0,050 |
| **4** | **50** | **1.5** | 0,020\* | 0,050 | 0,050 |
| **0.5** | **50** | **2** | 0,110\* | 0,050 | 0,050 |
| **1** | **50** | **2** | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **50** | **2** | 0,008\* | 0,050 | 0,050 |
| **0.5** | **100** | **0.5** | 0,017\* | 0,050 | 0,050 |
| **1** | **100** | **0.5** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **0.5** | 0,111\* | 0,050 | 0,050 |
| **4** | **100** | **0.5** | 0,151\* | 0,050 | 0,050 |
| **0.5** | **100** | **1** | 0,050 | 0,050 | 0,050 |
| **1** | **100** | **1** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **1** | 0,050 | 0,050 | 0,050 |
| **4** | **100** | **1** | 0,051 | 0,050 | 0,050 |
| **0.5** | **100** | **1.5** | 0,083\* | 0,050 | 0,050 |
| **1** | **100** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **1.5** | 0,027 | 0,050 | 0,050 |
| **4** | **100** | **1.5** | 0,020\* | 0,050 | 0,050 |
| **0.5** | **100** | **2** | 0,110\* | 0,050 | 0,050 |
| **1** | **100** | **2** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **100** | **2** | 0,008\* | 0,050 | 0,050 |

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| Table A3.1b  *Real alpha risk, when nominal alpha risk = 5%, three, four or five groups are compared and samples are extracted from normal distributions.* | | | | | | | | | | | |
|  |  |  | **Number of compared groups** | | | | | | | | |
|  |  |  | **3 groups** | | | **4 groups** | | | **5 groups** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test |
| **0.5** | **20** | **0.5** | 0,034 | 0,050 | 0,055 | 0,038 | 0,050 | 0,056 | 0,040 | 0,050 | 0,056 |
| **1** | **20** | **0.5** | 0,050 | 0,050 | 0,049 | 0,050 | 0,051 | 0,049 | 0,050 | 0,051 | 0,049 |
| **2** | **20** | **0.5** | 0,122\* | 0,051 | 0,060 | 0,124\* | 0,052 | 0,064 | 0,125\* | 0,052 | 0,068 |
| **4** | **20** | **0.5** | 0,199\* | 0,052 | 0,068 | 0,218\* | 0,052 | 0,079\* | 0,229\* | 0,052 | 0,087\* |
| **0.5** | **20** | **1** | 0,055 | 0,050 | 0,053 | 0,056 | 0,050 | 0,054 | 0,056 | 0,051 | 0,054 |
| **1** | **20** | **1** | 0,050 | 0,050 | 0,049 | 0,050 | 0,050 | 0,049 | 0,050 | 0,050 | 0,049 |
| **2** | **20** | **1** | 0,062 | 0,050 | 0,059 | 0,067 | 0,050 | 0,063 | 0,069 | 0,050 | 0,065 |
| **4** | **20** | **1** | 0,080\* | 0,050 | 0,071 | 0,096\* | 0,050 | 0,084\* | 0,108\* | 0,050 | 0,093\* |
| **0.5** | **20** | **1.5** | 0,079\* | 0,050 | 0,052 | 0,076\* | 0,051 | 0,053 | 0,073 | 0,051 | 0,053 |
| **1** | **20** | **1.5** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,049 |
| **2** | **20** | **1.5** | 0,034 | 0,050 | 0,057 | 0,038 | 0,050 | 0,062 | 0,042 | 0,051 | 0,065 |
| **4** | **20** | **1.5** | 0,036 | 0,050 | 0,071 | 0,046 | 0,050 | 0,085\* | 0,054 | 0,050 | 0,094\* |
| **0.5** | **20** | **2** | 0,103\* | 0,050 | 0,051 | 0,096\* | 0,050 | 0,052 | 0,092\* | 0,051 | 0,053 |
| **1** | **20** | **2** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **20** | **2** | 0,021\* | 0,049 | 0,056 | 0,024\* | 0,050 | 0,060 | 0,026 | 0,050 | 0,063 |
| **4** | **20** | **2** | 0,017\* | 0,050 | 0,070 | 0,023\* | 0,050 | 0,085\* | 0,028 | 0,051 | 0,094\* |
| **0.5** | **30** | **0.5** | 0,034 | 0,050 | 0,056 | 0,038 | 0,050 | 0,057 | 0,040 | 0,050 | 0,056 |
| **1** | **30** | **0.5** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,049 | 0,050 | 0,051 | 0,049 |
| **2** | **30** | **0.5** | 0,121\* | 0,051 | 0,060 | 0,124\* | 0,051 | 0,065 | 0,122\* | 0,051 | 0,067 |
| **4** | **30** | **0.5** | 0,194\* | 0,050 | 0,070 | 0,213\* | 0,051 | 0,082\* | 0,224\* | 0,051 | 0,091\* |
| **0.5** | **30** | **1** | 0,055 | 0,050 | 0,053 | 0,056 | 0,051 | 0,055 | 0,056 | 0,050 | 0,055 |
| **1** | **30** | **1** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **30** | **1** | 0,061 | 0,050 | 0,059 | 0,066 | 0,050 | 0,064 | 0,069 | 0,051 | 0,066 |
| **4** | **30** | **1** | 0,078\* | 0,050 | 0,072 | 0,094\* | 0,050 | 0,085\* | 0,105\* | 0,050 | 0,095\* |
| **0.5** | **30** | **1.5** | 0,078\* | 0,050 | 0,052 | 0,076\* | 0,051 | 0,054 | 0,073 | 0,050 | 0,054 |
| **1** | **30** | **1.5** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,049 | 0,049 | 0,049 |
| **2** | **30** | **1.5** | 0,034 | 0,050 | 0,058 | 0,038 | 0,050 | 0,062 | 0,041 | 0,050 | 0,065 |
| **4** | **30** | **1.5** | 0,035 | 0,050 | 0,071 | 0,046 | 0,050 | 0,087\* | 0,053 | 0,050 | 0,096\* |
| **0.5** | **30** | **2** | 0,102\* | 0,050 | 0,052 | 0,096\* | 0,050 | 0,052 | 0,092\* | 0,051 | 0,054 |
| **1** | **30** | **2** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,049 |
| **2** | **30** | **2** | 0,021\* | 0,050 | 0,057 | 0,023\* | 0,050 | 0,061 | 0,026 | 0,050 | 0,064 |
| **4** | **30** | **2** | 0,017\* | 0,050 | 0,072 | 0,022\* | 0,050 | 0,085\* | 0,028 | 0,050 | 0,095\* |
| **0.5** | **40** | **0.5** | 0,033 | 0,050 | 0,056 | 0,038 | 0,050 | 0,057 | 0,040 | 0,050 | 0,057 |
| **1** | **40** | **0.5** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **40** | **0.5** | 0,121\* | 0,050 | 0,060 | 0,122\* | 0,050 | 0,065 | 0,123\* | 0,050 | 0,068 |
| **4** | **40** | **0.5** | 0,192\* | 0,050 | 0,071 | 0,211\* | 0,050 | 0,085\* | 0,222\* | 0,051 | 0,094\* |
| **0.5** | **40** | **1** | 0,055 | 0,050 | 0,054 | 0,056 | 0,050 | 0,055 | 0,056 | 0,050 | 0,055 |
| **1** | **40** | **1** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **40** | **1** | 0,061 | 0,050 | 0,059 | 0,066 | 0,050 | 0,064 | 0,069 | 0,050 | 0,067 |
| **4** | **40** | **1** | 0,078\* | 0,050 | 0,072 | 0,094\* | 0,050 | 0,087\* | 0,105\* | 0,050 | 0,097\* |
| **0.5** | **40** | **1.5** | 0,078\* | 0,050 | 0,053 | 0,076\* | 0,050 | 0,054 | 0,073 | 0,050 | 0,054 |
| **1** | **40** | **1.5** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **40** | **1.5** | 0,034 | 0,050 | 0,058 | 0,038 | 0,050 | 0,063 | 0,041 | 0,050 | 0,065 |
| **4** | **40** | **1.5** | 0,035 | 0,050 | 0,072 | 0,045 | 0,050 | 0,087\* | 0,053 | 0,050 | 0,097\* |
| **0.5** | **40** | **2** | 0,102\* | 0,050 | 0,052 | 0,096\* | 0,050 | 0,053 | 0,091\* | 0,050 | 0,053 |
| **1** | **40** | **2** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,051 | 0,050 |
| **2** | **40** | **2** | 0,020\* | 0,050 | 0,056 | 0,023\* | 0,050 | 0,061 | 0,026 | 0,050 | 0,064 |
| **4** | **40** | **2** | 0,016\* | 0,050 | 0,072 | 0,022\* | 0,050 | 0,086\* | 0,028 | 0,050 | 0,097\* |
| **0.5** | **50** | **0.5** | 0,033 | 0,050 | 0,057 | 0,038 | 0,050 | 0,058 | 0,040 | 0,050 | 0,057 |
| **1** | **50** | **0.5** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **0.5** | 0,121\* | 0,050 | 0,060 | 0,122\* | 0,050 | 0,065 | 0,123\* | 0,051 | 0,069 |
| **4** | **50** | **0.5** | 0,190\* | 0,050 | 0,072 | 0,209\* | 0,050 | 0,086\* | 0,220\* | 0,050 | 0,096\* |
| **0.5** | **50** | **1** | 0,054 | 0,050 | 0,054 | 0,056 | 0,050 | 0,055 | 0,056 | 0,050 | 0,055 |
| **1** | **50** | **1** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **1** | 0,061 | 0,050 | 0,059 | 0,066 | 0,050 | 0,064 | 0,068 | 0,050 | 0,067 |
| **4** | **50** | **1** | 0,077\* | 0,050 | 0,073 | 0,093\* | 0,050 | 0,088\* | 0,104\* | 0,050 | 0,098\* |
| **0.5** | **50** | **1.5** | 0,078\* | 0,050 | 0,053 | 0,076\* | 0,050 | 0,054 | 0,073 | 0,050 | 0,054 |
| **1** | **50** | **1.5** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **1.5** | 0,034 | 0,050 | 0,058 | 0,038 | 0,050 | 0,062 | 0,041 | 0,050 | 0,066 |
| **4** | **50** | **1.5** | 0,034 | 0,050 | 0,072 | 0,044 | 0,050 | 0,087\* | 0,053 | 0,050 | 0,098\* |
| **0.5** | **50** | **2** | 0,101\* | 0,050 | 0,052 | 0,096\* | 0,050 | 0,053 | 0,091\* | 0,050 | 0,053 |
| **1** | **50** | **2** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **2** | 0,020\* | 0,050 | 0,057 | 0,023\* | 0,050 | 0,062 | 0,025 | 0,050 | 0,064 |
| **4** | **50** | **2** | 0,016\* | 0,050 | 0,072 | 0,022\* | 0,050 | 0,087\* | 0,028 | 0,050 | 0,097\* |
| **0.5** | **100** | **0.5** | 0,033 | 0,050 | 0,057 | 0,038 | 0,050 | 0,058 | 0,040 | 0,050 | 0,057 |
| **1** | **100** | **0.5** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **0.5** | 0,120\* | 0,050 | 0,061 | 0,122\* | 0,050 | 0,066 | 0,122\* | 0,050 | 0,069 |
| **4** | **100** | **0.5** | 0,187\* | 0,050 | 0,074 | 0,206\* | 0,050 | 0,090\* | 0,217\* | 0,050 | 0,099\* |
| **0.5** | **100** | **1** | 0,055 | 0,050 | 0,054 | 0,056 | 0,050 | 0,056 | 0,056 | 0,050 | 0,056 |
| **1** | **100** | **1** | 0,050 | 0,051 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **1** | 0,060 | 0,050 | 0,059 | 0,065 | 0,050 | 0,065 | 0,068 | 0,050 | 0,068 |
| **4** | **100** | **1** | 0,076\* | 0,050 | 0,074 | 0,092\* | 0,050 | 0,090\* | 0,103\* | 0,051 | 0,100\* |
| **0.5** | **100** | **1.5** | 0,078\* | 0,050 | 0,053 | 0,075 | 0,050 | 0,054 | 0,073 | 0,050 | 0,054 |
| **1** | **100** | **1.5** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **1.5** | 0,033 | 0,050 | 0,058 | 0,037 | 0,050 | 0,062 | 0,041 | 0,050 | 0,066 |
| **4** | **100** | **1.5** | 0,034 | 0,050 | 0,073 | 0,044 | 0,050 | 0,088\* | 0,052 | 0,050 | 0,099\* |
| **0.5** | **100** | **2** | 0,101\* | 0,050 | 0,052 | 0,095\* | 0,050 | 0,053 | 0,091\* | 0,050 | 0,054 |
| **1** | **100** | **2** | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **2** | 0,020\* | 0,050 | 0,057 | 0,023\* | 0,050 | 0,061 | 0,025 | 0,050 | 0,064 |
| **4** | **100** | **2** | 0,016\* | 0,050 | 0,073 | 0,022\* | 0,050 | 0,087\* | 0,028 | 0,050 | 0,098\* |

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| Table A3.2a  *Real alpha risk, when nominal alpha risk = 5%, two groups are compared and samples are extracted from double exponential distributions.* | | | | | |
|  |  |  | **Test** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | Welch | B-F |
| **0.5** | **20** | **0.5** | 0,018\* | 0,047 | 0,047 |
| **1** | **20** | **0.5** | 0,048 | 0,045 | 0,045 |
| **2** | **20** | **0.5** | 0,107\* | 0,044 | 0,044 |
| **4** | **20** | **0.5** | 0,159\* | 0,043 | 0,043 |
| **0.5** | **20** | **1** | 0,050 | 0,047 | 0,047 |
| **1** | **20** | **1** | 0,049 | 0,048 | 0,048 |
| **2** | **20** | **1** | 0,050 | 0,047 | 0,047 |
| **4** | **20** | **1** | 0,052 | 0,047 | 0,047 |
| **0.5** | **20** | **1.5** | 0,082\* | 0,048 | 0,048 |
| **1** | **20** | **1.5** | 0,049 | 0,048 | 0,048 |
| **2** | **20** | **1.5** | 0,028 | 0,048 | 0,048 |
| **4** | **20** | **1.5** | 0,020\* | 0,048 | 0,048 |
| **0.5** | **20** | **2** | 0,109\* | 0,047 | 0,047 |
| **1** | **20** | **2** | 0,049 | 0,048 | 0,048 |
| **2** | **20** | **2** | 0,017\* | 0,049 | 0,049 |
| **4** | **20** | **2** | 0,008\* | 0,048 | 0,048 |
| **0.5** | **30** | **0.5** | 0,018\* | 0,048 | 0,048 |
| **1** | **30** | **0.5** | 0,049 | 0,048 | 0,048 |
| **2** | **30** | **0.5** | 0,108\* | 0,046 | 0,046 |
| **4** | **30** | **0.5** | 0,156\* | 0,045 | 0,045 |
| **0.5** | **30** | **1** | 0,050 | 0,048 | 0,048 |
| **1** | **30** | **1** | 0,049 | 0,049 | 0,049 |
| **2** | **30** | **1** | 0,050 | 0,048 | 0,048 |
| **4** | **30** | **1** | 0,052 | 0,048 | 0,048 |
| **0.5** | **30** | **1.5** | 0,082\* | 0,049 | 0,049 |
| **1** | **30** | **1.5** | 0,050 | 0,049 | 0,049 |
| **2** | **30** | **1.5** | 0,028 | 0,049 | 0,049 |
| **4** | **30** | **1.5** | 0,020\* | 0,049 | 0,049 |
| **0.5** | **30** | **2** | 0,109\* | 0,048 | 0,048 |
| **1** | **30** | **2** | 0,049 | 0,049 | 0,049 |
| **2** | **30** | **2** | 0,017\* | 0,049 | 0,049 |
| **4** | **30** | **2** | 0,008\* | 0,049 | 0,049 |
| **0.5** | **40** | **0.5** | 0,017\* | 0,049 | 0,049 |
| **1** | **40** | **0.5** | 0,049 | 0,048 | 0,048 |
| **2** | **40** | **0.5** | 0,109\* | 0,047 | 0,047 |
| **4** | **40** | **0.5** | 0,155\* | 0,047 | 0,047 |
| **0.5** | **40** | **1** | 0,050 | 0,049 | 0,049 |
| **1** | **40** | **1** | 0,050 | 0,049 | 0,049 |
| **2** | **40** | **1** | 0,050 | 0,049 | 0,049 |
| **4** | **40** | **1** | 0,051 | 0,048 | 0,048 |
| **0.5** | **40** | **1.5** | 0,082\* | 0,049 | 0,049 |
| **1** | **40** | **1.5** | 0,049 | 0,049 | 0,049 |
| **2** | **40** | **1.5** | 0,027 | 0,049 | 0,049 |
| **4** | **40** | **1.5** | 0,020\* | 0,049 | 0,049 |
| **0.5** | **40** | **2** | 0,109\* | 0,049 | 0,049 |
| **1** | **40** | **2** | 0,050 | 0,049 | 0,049 |
| **2** | **40** | **2** | 0,017\* | 0,049 | 0,049 |
| **4** | **40** | **2** | 0,008\* | 0,050 | 0,050 |
| **0.5** | **50** | **0.5** | 0,017\* | 0,049 | 0,049 |
| **1** | **50** | **0.5** | 0,049 | 0,048 | 0,048 |
| **2** | **50** | **0.5** | 0,109\* | 0,048 | 0,048 |
| **4** | **50** | **0.5** | 0,153\* | 0,047 | 0,047 |
| **0.5** | **50** | **1** | 0,050 | 0,049 | 0,049 |
| **1** | **50** | **1** | 0,050 | 0,049 | 0,049 |
| **2** | **50** | **1** | 0,051 | 0,050 | 0,050 |
| **4** | **50** | **1** | 0,051 | 0,049 | 0,049 |
| **0.5** | **50** | **1.5** | 0,082\* | 0,049 | 0,049 |
| **1** | **50** | **1.5** | 0,049 | 0,049 | 0,049 |
| **2** | **50** | **1.5** | 0,027 | 0,049 | 0,049 |
| **4** | **50** | **1.5** | 0,019\* | 0,049 | 0,049 |
| **0.5** | **50** | **2** | 0,109\* | 0,049 | 0,049 |
| **1** | **50** | **2** | 0,050 | 0,049 | 0,049 |
| **2** | **50** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **50** | **2** | 0,008\* | 0,049 | 0,049 |
| **0.5** | **100** | **0.5** | 0,017\* | 0,050 | 0,050 |
| **1** | **100** | **0.5** | 0,050 | 0,049 | 0,049 |
| **2** | **100** | **0.5** | 0,109\* | 0,049 | 0,049 |
| **4** | **100** | **0.5** | 0,151\* | 0,049 | 0,049 |
| **0.5** | **100** | **1** | 0,050 | 0,050 | 0,050 |
| **1** | **100** | **1** | 0,049 | 0,049 | 0,049 |
| **2** | **100** | **1** | 0,050 | 0,050 | 0,050 |
| **4** | **100** | **1** | 0,050 | 0,049 | 0,049 |
| **0.5** | **100** | **1.5** | 0,083\* | 0,050 | 0,050 |
| **1** | **100** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **1.5** | 0,027 | 0,050 | 0,050 |
| **4** | **100** | **1.5** | 0,019\* | 0,050 | 0,050 |
| **0.5** | **100** | **2** | 0,110\* | 0,050 | 0,050 |
| **1** | **100** | **2** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **100** | **2** | 0,008\* | 0,050 | 0,050 |

|  |  |  |  |  |  |  |  |  |  |  |  |
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| Table A3.2b  *Real alpha risk, when nominal alpha risk = 5%, three, four or five groups are compared and samples are extracted from double exponential distributions.* | | | | | | | | | | | |
|  |  |  | **Number of compared groups** | | | | | | | | |
|  |  |  | **3 groups** | | | **4 groups** | | | **5 groups** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test |
| **0.5** | **20** | **0.5** | 0,032 | 0,044 | 0,053 | 0,036 | 0,043 | 0,054 | 0,038 | 0,042 | 0,053 |
| **1** | **20** | **0.5** | 0,048 | 0,043 | 0,046 | 0,049 | 0,043 | 0,046 | 0,049 | 0,042 | 0,046 |
| **2** | **20** | **0.5** | 0,115\* | 0,043 | 0,051 | 0,118\* | 0,043 | 0,056 | 0,118\* | 0,043 | 0,058 |
| **4** | **20** | **0.5** | 0,197\* | 0,043 | 0,060 | 0,216\* | 0,043 | 0,071 | 0,226\* | 0,042 | 0,079\* |
| **0.5** | **20** | **1** | 0,053 | 0,045 | 0,051 | 0,054 | 0,044 | 0,052 | 0,054 | 0,043 | 0,052 |
| **1** | **20** | **1** | 0,048 | 0,045 | 0,047 | 0,048 | 0,044 | 0,047 | 0,048 | 0,043 | 0,047 |
| **2** | **20** | **1** | 0,058 | 0,045 | 0,055 | 0,064 | 0,044 | 0,059 | 0,066 | 0,043 | 0,062 |
| **4** | **20** | **1** | 0,077\* | 0,045 | 0,067 | 0,093\* | 0,044 | 0,080\* | 0,104\* | 0,043 | 0,089\* |
| **0.5** | **20** | **1.5** | 0,077\* | 0,045 | 0,049 | 0,073 | 0,044 | 0,050 | 0,071 | 0,043 | 0,051 |
| **1** | **20** | **1.5** | 0,048 | 0,046 | 0,047 | 0,049 | 0,044 | 0,047 | 0,049 | 0,043 | 0,047 |
| **2** | **20** | **1.5** | 0,033 | 0,046 | 0,055 | 0,037 | 0,045 | 0,060 | 0,040 | 0,044 | 0,062 |
| **4** | **20** | **1.5** | 0,033 | 0,046 | 0,069 | 0,044 | 0,044 | 0,083\* | 0,052 | 0,044 | 0,093\* |
| **0.5** | **20** | **2** | 0,100\* | 0,045 | 0,049 | 0,094\* | 0,044 | 0,050 | 0,090\* | 0,044 | 0,050 |
| **1** | **20** | **2** | 0,049 | 0,046 | 0,048 | 0,049 | 0,045 | 0,047 | 0,049 | 0,044 | 0,047 |
| **2** | **20** | **2** | 0,020\* | 0,047 | 0,055 | 0,023\* | 0,045 | 0,058 | 0,025 | 0,045 | 0,062 |
| **4** | **20** | **2** | 0,016\* | 0,047 | 0,070 | 0,021\* | 0,045 | 0,083\* | 0,026 | 0,044 | 0,092\* |
| **0.5** | **30** | **0.5** | 0,032 | 0,046 | 0,054 | 0,037 | 0,045 | 0,055 | 0,039 | 0,044 | 0,054 |
| **1** | **30** | **0.5** | 0,049 | 0,046 | 0,047 | 0,049 | 0,045 | 0,048 | 0,049 | 0,045 | 0,048 |
| **2** | **30** | **0.5** | 0,117\* | 0,045 | 0,055 | 0,119\* | 0,045 | 0,059 | 0,119\* | 0,044 | 0,062 |
| **4** | **30** | **0.5** | 0,193\* | 0,045 | 0,065 | 0,213\* | 0,045 | 0,078\* | 0,223\* | 0,045 | 0,087\* |
| **0.5** | **30** | **1** | 0,054 | 0,047 | 0,052 | 0,055 | 0,046 | 0,053 | 0,054 | 0,045 | 0,053 |
| **1** | **30** | **1** | 0,049 | 0,047 | 0,048 | 0,048 | 0,046 | 0,048 | 0,049 | 0,045 | 0,048 |
| **2** | **30** | **1** | 0,060 | 0,047 | 0,057 | 0,065 | 0,046 | 0,062 | 0,067 | 0,046 | 0,064 |
| **4** | **30** | **1** | 0,076\* | 0,047 | 0,069 | 0,093\* | 0,046 | 0,084\* | 0,104\* | 0,045 | 0,094\* |
| **0.5** | **30** | **1.5** | 0,077\* | 0,047 | 0,051 | 0,074 | 0,046 | 0,052 | 0,072 | 0,046 | 0,052 |
| **1** | **30** | **1.5** | 0,049 | 0,047 | 0,048 | 0,049 | 0,046 | 0,048 | 0,049 | 0,046 | 0,048 |
| **2** | **30** | **1.5** | 0,033 | 0,048 | 0,056 | 0,037 | 0,046 | 0,061 | 0,040 | 0,046 | 0,064 |
| **4** | **30** | **1.5** | 0,033 | 0,047 | 0,070 | 0,044 | 0,047 | 0,085\* | 0,051 | 0,046 | 0,095\* |
| **0.5** | **30** | **2** | 0,100\* | 0,046 | 0,050 | 0,094\* | 0,046 | 0,051 | 0,090\* | 0,046 | 0,051 |
| **1** | **30** | **2** | 0,049 | 0,047 | 0,048 | 0,050 | 0,047 | 0,049 | 0,049 | 0,045 | 0,048 |
| **2** | **30** | **2** | 0,020\* | 0,048 | 0,055 | 0,022\* | 0,046 | 0,060 | 0,025 | 0,046 | 0,063 |
| **4** | **30** | **2** | 0,016\* | 0,048 | 0,071 | 0,022\* | 0,047 | 0,085\* | 0,027 | 0,046 | 0,095\* |
| **0.5** | **40** | **0.5** | 0,033 | 0,047 | 0,055 | 0,037 | 0,046 | 0,056 | 0,039 | 0,046 | 0,055 |
| **1** | **40** | **0.5** | 0,049 | 0,047 | 0,048 | 0,049 | 0,046 | 0,048 | 0,049 | 0,046 | 0,048 |
| **2** | **40** | **0.5** | 0,119\* | 0,047 | 0,057 | 0,120\* | 0,046 | 0,061 | 0,119\* | 0,045 | 0,064 |
| **4** | **40** | **0.5** | 0,192\* | 0,046 | 0,068 | 0,211\* | 0,046 | 0,081\* | 0,221\* | 0,046 | 0,090\* |
| **0.5** | **40** | **1** | 0,054 | 0,048 | 0,053 | 0,055 | 0,047 | 0,054 | 0,055 | 0,046 | 0,054 |
| **1** | **40** | **1** | 0,049 | 0,048 | 0,049 | 0,049 | 0,047 | 0,049 | 0,049 | 0,046 | 0,049 |
| **2** | **40** | **1** | 0,059 | 0,048 | 0,058 | 0,064 | 0,047 | 0,062 | 0,068 | 0,047 | 0,065 |
| **4** | **40** | **1** | 0,076\* | 0,048 | 0,071 | 0,093\* | 0,047 | 0,086\* | 0,103\* | 0,046 | 0,096\* |
| **0.5** | **40** | **1.5** | 0,077\* | 0,048 | 0,052 | 0,075 | 0,047 | 0,053 | 0,072 | 0,046 | 0,053 |
| **1** | **40** | **1.5** | 0,049 | 0,048 | 0,049 | 0,049 | 0,047 | 0,049 | 0,050 | 0,047 | 0,049 |
| **2** | **40** | **1.5** | 0,033 | 0,048 | 0,057 | 0,037 | 0,048 | 0,061 | 0,040 | 0,047 | 0,064 |
| **4** | **40** | **1.5** | 0,033 | 0,048 | 0,071 | 0,044 | 0,047 | 0,086\* | 0,051 | 0,047 | 0,096\* |
| **0.5** | **40** | **2** | 0,101\* | 0,048 | 0,051 | 0,095\* | 0,047 | 0,052 | 0,090\* | 0,046 | 0,052 |
| **1** | **40** | **2** | 0,049 | 0,048 | 0,049 | 0,049 | 0,047 | 0,049 | 0,050 | 0,047 | 0,049 |
| **2** | **40** | **2** | 0,020\* | 0,048 | 0,056 | 0,023\* | 0,047 | 0,061 | 0,025 | 0,047 | 0,063 |
| **4** | **40** | **2** | 0,016\* | 0,049 | 0,071 | 0,022\* | 0,048 | 0,086\* | 0,027 | 0,047 | 0,096\* |
| **0.5** | **50** | **0.5** | 0,033 | 0,048 | 0,056 | 0,037 | 0,047 | 0,056 | 0,039 | 0,047 | 0,056 |
| **1** | **50** | **0.5** | 0,049 | 0,047 | 0,049 | 0,050 | 0,047 | 0,049 | 0,049 | 0,047 | 0,049 |
| **2** | **50** | **0.5** | 0,119\* | 0,047 | 0,058 | 0,120\* | 0,047 | 0,063 | 0,119\* | 0,047 | 0,065 |
| **4** | **50** | **0.5** | 0,191\* | 0,047 | 0,070 | 0,209\* | 0,047 | 0,083\* | 0,220\* | 0,047 | 0,093\* |
| **0.5** | **50** | **1** | 0,054 | 0,048 | 0,053 | 0,055 | 0,047 | 0,054 | 0,055 | 0,047 | 0,054 |
| **1** | **50** | **1** | 0,049 | 0,048 | 0,049 | 0,049 | 0,048 | 0,049 | 0,049 | 0,047 | 0,049 |
| **2** | **50** | **1** | 0,059 | 0,048 | 0,058 | 0,065 | 0,048 | 0,063 | 0,067 | 0,047 | 0,065 |
| **4** | **50** | **1** | 0,076\* | 0,048 | 0,072 | 0,092\* | 0,048 | 0,087\* | 0,103\* | 0,047 | 0,097\* |
| **0.5** | **50** | **1.5** | 0,077\* | 0,048 | 0,052 | 0,075 | 0,048 | 0,053 | 0,072 | 0,047 | 0,053 |
| **1** | **50** | **1.5** | 0,049 | 0,048 | 0,049 | 0,050 | 0,048 | 0,049 | 0,049 | 0,047 | 0,049 |
| **2** | **50** | **1.5** | 0,033 | 0,049 | 0,058 | 0,037 | 0,048 | 0,062 | 0,040 | 0,048 | 0,065 |
| **4** | **50** | **1.5** | 0,033 | 0,048 | 0,072 | 0,044 | 0,048 | 0,087\* | 0,052 | 0,047 | 0,097\* |
| **0.5** | **50** | **2** | 0,100\* | 0,047 | 0,050 | 0,095\* | 0,048 | 0,052 | 0,090\* | 0,048 | 0,053 |
| **1** | **50** | **2** | 0,050 | 0,049 | 0,049 | 0,050 | 0,048 | 0,050 | 0,050 | 0,048 | 0,049 |
| **2** | **50** | **2** | 0,020\* | 0,049 | 0,056 | 0,023\* | 0,048 | 0,061 | 0,025 | 0,048 | 0,063 |
| **4** | **50** | **2** | 0,016\* | 0,049 | 0,072 | 0,022\* | 0,048 | 0,086\* | 0,027 | 0,048 | 0,097\* |
| **0.5** | **100** | **0.5** | 0,033 | 0,049 | 0,057 | 0,038 | 0,048 | 0,057 | 0,040 | 0,049 | 0,057 |
| **1** | **100** | **0.5** | 0,050 | 0,049 | 0,049 | 0,050 | 0,049 | 0,050 | 0,050 | 0,048 | 0,050 |
| **2** | **100** | **0.5** | 0,119\* | 0,049 | 0,060 | 0,121\* | 0,048 | 0,065 | 0,121\* | 0,048 | 0,068 |
| **4** | **100** | **0.5** | 0,188\* | 0,049 | 0,073 | 0,206\* | 0,048 | 0,088\* | 0,217\* | 0,048 | 0,098\* |
| **0.5** | **100** | **1** | 0,054 | 0,049 | 0,054 | 0,055 | 0,049 | 0,055 | 0,056 | 0,049 | 0,055 |
| **1** | **100** | **1** | 0,050 | 0,049 | 0,050 | 0,050 | 0,049 | 0,050 | 0,049 | 0,049 | 0,049 |
| **2** | **100** | **1** | 0,060 | 0,049 | 0,059 | 0,065 | 0,049 | 0,064 | 0,068 | 0,049 | 0,067 |
| **4** | **100** | **1** | 0,076\* | 0,049 | 0,073 | 0,092\* | 0,049 | 0,089\* | 0,103\* | 0,048 | 0,099\* |
| **0.5** | **100** | **1.5** | 0,077\* | 0,049 | 0,052 | 0,075 | 0,049 | 0,054 | 0,072 | 0,049 | 0,054 |
| **1** | **100** | **1.5** | 0,049 | 0,049 | 0,049 | 0,050 | 0,049 | 0,050 | 0,050 | 0,048 | 0,049 |
| **2** | **100** | **1.5** | 0,033 | 0,049 | 0,058 | 0,037 | 0,049 | 0,063 | 0,040 | 0,049 | 0,066 |
| **4** | **100** | **1.5** | 0,033 | 0,049 | 0,073 | 0,044 | 0,049 | 0,088\* | 0,052 | 0,049 | 0,099\* |
| **0.5** | **100** | **2** | 0,101\* | 0,049 | 0,051 | 0,095\* | 0,048 | 0,052 | 0,091\* | 0,049 | 0,054 |
| **1** | **100** | **2** | 0,050 | 0,050 | 0,050 | 0,050 | 0,049 | 0,050 | 0,050 | 0,049 | 0,050 |
| **2** | **100** | **2** | 0,020\* | 0,049 | 0,056 | 0,023\* | 0,049 | 0,061 | 0,025 | 0,049 | 0,064 |
| **4** | **100** | **2** | 0,015\* | 0,049 | 0,072 | 0,022\* | 0,049 | 0,087\* | 0,027 | 0,049 | 0,097\* |

|  |  |  |  |  |  |
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| Table A3.3a  *Real alpha risk, when nominal alpha risk = 5%, two groups are compared and samples are extracted from mixed normal distributions.* | | | | | |
|  |  |  | **Test** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | Welch | B-F |
| **0.5** | **20** | **0.5** | 0,017\* | 0,041 | 0,041 |
| **1** | **20** | **0.5** | 0,045 | 0,040 | 0,040 |
| **2** | **20** | **0.5** | 0,098\* | 0,040 | 0,040 |
| **4** | **20** | **0.5** | 0,147\* | 0,040 | 0,040 |
| **0.5** | **20** | **1** | 0,045 | 0,043 | 0,043 |
| **1** | **20** | **1** | 0,044 | 0,043 | 0,043 |
| **2** | **20** | **1** | 0,045 | 0,043 | 0,043 |
| **4** | **20** | **1** | 0,046 | 0,042 | 0,042 |
| **0.5** | **20** | **1.5** | 0,076\* | 0,043 | 0,043 |
| **1** | **20** | **1.5** | 0,046 | 0,044 | 0,044 |
| **2** | **20** | **1.5** | 0,026 | 0,045 | 0,045 |
| **4** | **20** | **1.5** | 0,017\* | 0,043 | 0,043 |
| **0.5** | **20** | **2** | 0,103\* | 0,042 | 0,042 |
| **1** | **20** | **2** | 0,048 | 0,044 | 0,044 |
| **2** | **20** | **2** | 0,017\* | 0,046 | 0,046 |
| **4** | **20** | **2** | 0,007\* | 0,045 | 0,045 |
| **0.5** | **30** | **0.5** | 0,017\* | 0,044 | 0,044 |
| **1** | **30** | **0.5** | 0,046 | 0,043 | 0,043 |
| **2** | **30** | **0.5** | 0,101\* | 0,041 | 0,041 |
| **4** | **30** | **0.5** | 0,148\* | 0,040 | 0,040 |
| **0.5** | **30** | **1** | 0,047 | 0,045 | 0,045 |
| **1** | **30** | **1** | 0,046 | 0,046 | 0,046 |
| **2** | **30** | **1** | 0,046 | 0,045 | 0,045 |
| **4** | **30** | **1** | 0,047 | 0,043 | 0,043 |
| **0.5** | **30** | **1.5** | 0,078\* | 0,044 | 0,044 |
| **1** | **30** | **1.5** | 0,048 | 0,046 | 0,046 |
| **2** | **30** | **1.5** | 0,026 | 0,047 | 0,047 |
| **4** | **30** | **1.5** | 0,017\* | 0,046 | 0,046 |
| **0.5** | **30** | **2** | 0,105\* | 0,044 | 0,044 |
| **1** | **30** | **2** | 0,048 | 0,046 | 0,046 |
| **2** | **30** | **2** | 0,017\* | 0,048 | 0,048 |
| **4** | **30** | **2** | 0,007\* | 0,047 | 0,047 |
| **0.5** | **40** | **0.5** | 0,017\* | 0,046 | 0,046 |
| **1** | **40** | **0.5** | 0,048 | 0,045 | 0,045 |
| **2** | **40** | **0.5** | 0,103\* | 0,043 | 0,043 |
| **4** | **40** | **0.5** | 0,149\* | 0,041 | 0,041 |
| **0.5** | **40** | **1** | 0,048 | 0,047 | 0,047 |
| **1** | **40** | **1** | 0,047 | 0,047 | 0,047 |
| **2** | **40** | **1** | 0,047 | 0,046 | 0,046 |
| **4** | **40** | **1** | 0,048 | 0,045 | 0,045 |
| **0.5** | **40** | **1.5** | 0,079\* | 0,046 | 0,046 |
| **1** | **40** | **1.5** | 0,048 | 0,048 | 0,048 |
| **2** | **40** | **1.5** | 0,026 | 0,047 | 0,047 |
| **4** | **40** | **1.5** | 0,018\* | 0,047 | 0,047 |
| **0.5** | **40** | **2** | 0,106\* | 0,046 | 0,046 |
| **1** | **40** | **2** | 0,049 | 0,047 | 0,047 |
| **2** | **40** | **2** | 0,016\* | 0,048 | 0,048 |
| **4** | **40** | **2** | 0,007\* | 0,048 | 0,048 |
| **0.5** | **50** | **0.5** | 0,016\* | 0,047 | 0,047 |
| **1** | **50** | **0.5** | 0,048 | 0,045 | 0,045 |
| **2** | **50** | **0.5** | 0,104\* | 0,043 | 0,043 |
| **4** | **50** | **0.5** | 0,150\* | 0,042 | 0,042 |
| **0.5** | **50** | **1** | 0,048 | 0,047 | 0,047 |
| **1** | **50** | **1** | 0,048 | 0,048 | 0,048 |
| **2** | **50** | **1** | 0,048 | 0,047 | 0,047 |
| **4** | **50** | **1** | 0,048 | 0,046 | 0,046 |
| **0.5** | **50** | **1.5** | 0,080\* | 0,046 | 0,046 |
| **1** | **50** | **1.5** | 0,049 | 0,048 | 0,048 |
| **2** | **50** | **1.5** | 0,027 | 0,048 | 0,048 |
| **4** | **50** | **1.5** | 0,018\* | 0,047 | 0,047 |
| **0.5** | **50** | **2** | 0,107\* | 0,047 | 0,047 |
| **1** | **50** | **2** | 0,049 | 0,048 | 0,048 |
| **2** | **50** | **2** | 0,016\* | 0,049 | 0,049 |
| **4** | **50** | **2** | 0,008\* | 0,048 | 0,048 |
| **0.5** | **100** | **0.5** | 0,016\* | 0,048 | 0,048 |
| **1** | **100** | **0.5** | 0,049 | 0,048 | 0,048 |
| **2** | **100** | **0.5** | 0,107\* | 0,046 | 0,046 |
| **4** | **100** | **0.5** | 0,151\* | 0,046 | 0,046 |
| **0.5** | **100** | **1** | 0,049 | 0,049 | 0,049 |
| **1** | **100** | **1** | 0,049 | 0,049 | 0,049 |
| **2** | **100** | **1** | 0,049 | 0,048 | 0,048 |
| **4** | **100** | **1** | 0,049 | 0,048 | 0,048 |
| **0.5** | **100** | **1.5** | 0,081\* | 0,048 | 0,048 |
| **1** | **100** | **1.5** | 0,049 | 0,049 | 0,049 |
| **2** | **100** | **1.5** | 0,027 | 0,049 | 0,049 |
| **4** | **100** | **1.5** | 0,019\* | 0,049 | 0,049 |
| **0.5** | **100** | **2** | 0,109\* | 0,048 | 0,048 |
| **1** | **100** | **2** | 0,049 | 0,049 | 0,049 |
| **2** | **100** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **100** | **2** | 0,008\* | 0,049 | 0,049 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A3.3b  *Real alpha risk, when nominal alpha risk = 5%, three, four or five groups are compared and samples are extracted from mixed normal distributions.* | | | | | | | | | | | |
|  |  |  | **Number of compared groups** | | | | | | | | |
|  |  |  | **3 groups** | | | **4 groups** | | | **5 groups** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test |
| **0.5** | **20** | **0.5** | 0,029 | 0,037 | 0,048 | 0,033 | 0,036 | 0,048 | 0,029 | 0,037 | 0,048 |
| **1** | **20** | **0.5** | 0,045 | 0,038 | 0,040 | 0,045 | 0,037 | 0,040 | 0,045 | 0,038 | 0,040 |
| **2** | **20** | **0.5** | 0,105\* | 0,039 | 0,044 | 0,106\* | 0,037 | 0,046 | 0,105\* | 0,039 | 0,044 |
| **4** | **20** | **0.5** | 0,184\* | 0,039 | 0,053 | 0,202\* | 0,038 | 0,062 | 0,184\* | 0,039 | 0,053 |
| **0.5** | **20** | **1** | 0,049 | 0,039 | 0,045 | 0,049 | 0,037 | 0,046 | 0,049 | 0,039 | 0,045 |
| **1** | **20** | **1** | 0,044 | 0,039 | 0,042 | 0,044 | 0,037 | 0,042 | 0,044 | 0,039 | 0,042 |
| **2** | **20** | **1** | 0,052 | 0,038 | 0,048 | 0,057 | 0,037 | 0,052 | 0,052 | 0,038 | 0,048 |
| **4** | **20** | **1** | 0,069 | 0,039 | 0,060 | 0,085\* | 0,037 | 0,072 | 0,069 | 0,039 | 0,060 |
| **0.5** | **20** | **1.5** | 0,071 | 0,039 | 0,044 | 0,069 | 0,038 | 0,045 | 0,071 | 0,039 | 0,044 |
| **1** | **20** | **1.5** | 0,045 | 0,040 | 0,043 | 0,045 | 0,038 | 0,043 | 0,045 | 0,040 | 0,043 |
| **2** | **20** | **1.5** | 0,030 | 0,040 | 0,051 | 0,034 | 0,038 | 0,055 | 0,030 | 0,040 | 0,051 |
| **4** | **20** | **1.5** | 0,029 | 0,040 | 0,063 | 0,038 | 0,038 | 0,077\* | 0,029 | 0,040 | 0,063 |
| **0.5** | **20** | **2** | 0,094\* | 0,039 | 0,043 | 0,089\* | 0,038 | 0,044 | 0,094\* | 0,039 | 0,043 |
| **1** | **20** | **2** | 0,046 | 0,040 | 0,043 | 0,046 | 0,038 | 0,043 | 0,046 | 0,040 | 0,043 |
| **2** | **20** | **2** | 0,019\* | 0,041 | 0,051 | 0,021\* | 0,038 | 0,055 | 0,019\* | 0,041 | 0,051 |
| **4** | **20** | **2** | 0,013\* | 0,040 | 0,065 | 0,018\* | 0,038 | 0,078\* | 0,013\* | 0,040 | 0,065 |
| **0.5** | **30** | **0.5** | 0,030 | 0,040 | 0,051 | 0,034 | 0,038 | 0,052 | 0,030 | 0,040 | 0,051 |
| **1** | **30** | **0.5** | 0,046 | 0,040 | 0,043 | 0,046 | 0,038 | 0,043 | 0,046 | 0,040 | 0,043 |
| **2** | **30** | **0.5** | 0,107\* | 0,040 | 0,047 | 0,110\* | 0,039 | 0,051 | 0,107\* | 0,040 | 0,047 |
| **4** | **30** | **0.5** | 0,185\* | 0,040 | 0,057 | 0,204\* | 0,039 | 0,068 | 0,185\* | 0,040 | 0,057 |
| **0.5** | **30** | **1** | 0,050 | 0,041 | 0,048 | 0,052 | 0,040 | 0,050 | 0,050 | 0,041 | 0,048 |
| **1** | **30** | **1** | 0,046 | 0,041 | 0,045 | 0,046 | 0,039 | 0,045 | 0,046 | 0,041 | 0,045 |
| **2** | **30** | **1** | 0,054 | 0,041 | 0,052 | 0,060 | 0,040 | 0,056 | 0,054 | 0,041 | 0,052 |
| **4** | **30** | **1** | 0,072 | 0,041 | 0,065 | 0,087\* | 0,040 | 0,078\* | 0,072 | 0,041 | 0,065 |
| **0.5** | **30** | **1.5** | 0,073 | 0,041 | 0,047 | 0,071 | 0,040 | 0,048 | 0,073 | 0,041 | 0,047 |
| **1** | **30** | **1.5** | 0,046 | 0,042 | 0,045 | 0,047 | 0,040 | 0,045 | 0,046 | 0,042 | 0,045 |
| **2** | **30** | **1.5** | 0,031 | 0,042 | 0,053 | 0,035 | 0,041 | 0,058 | 0,031 | 0,042 | 0,053 |
| **4** | **30** | **1.5** | 0,030 | 0,043 | 0,067 | 0,040 | 0,041 | 0,082\* | 0,030 | 0,043 | 0,067 |
| **0.5** | **30** | **2** | 0,097\* | 0,041 | 0,046 | 0,091\* | 0,039 | 0,047 | 0,097\* | 0,041 | 0,046 |
| **1** | **30** | **2** | 0,048 | 0,042 | 0,045 | 0,048 | 0,041 | 0,046 | 0,048 | 0,042 | 0,045 |
| **2** | **30** | **2** | 0,019\* | 0,043 | 0,053 | 0,022\* | 0,041 | 0,058 | 0,019\* | 0,043 | 0,053 |
| **4** | **30** | **2** | 0,013\* | 0,043 | 0,068 | 0,019\* | 0,041 | 0,083\* | 0,013\* | 0,043 | 0,068 |
| **0.5** | **40** | **0.5** | 0,031 | 0,042 | 0,052 | 0,035 | 0,040 | 0,053 | 0,031 | 0,042 | 0,052 |
| **1** | **40** | **0.5** | 0,047 | 0,042 | 0,045 | 0,047 | 0,040 | 0,045 | 0,047 | 0,042 | 0,045 |
| **2** | **40** | **0.5** | 0,111\* | 0,041 | 0,050 | 0,113\* | 0,040 | 0,054 | 0,111\* | 0,041 | 0,050 |
| **4** | **40** | **0.5** | 0,187\* | 0,041 | 0,061 | 0,205\* | 0,040 | 0,073 | 0,187\* | 0,041 | 0,061 |
| **0.5** | **40** | **1** | 0,051 | 0,043 | 0,050 | 0,052 | 0,041 | 0,051 | 0,051 | 0,043 | 0,050 |
| **1** | **40** | **1** | 0,047 | 0,043 | 0,046 | 0,047 | 0,041 | 0,046 | 0,047 | 0,043 | 0,046 |
| **2** | **40** | **1** | 0,056 | 0,043 | 0,053 | 0,061 | 0,041 | 0,058 | 0,056 | 0,043 | 0,053 |
| **4** | **40** | **1** | 0,072 | 0,043 | 0,067 | 0,089\* | 0,041 | 0,082\* | 0,072 | 0,043 | 0,067 |
| **0.5** | **40** | **1.5** | 0,074 | 0,043 | 0,049 | 0,072 | 0,042 | 0,050 | 0,074 | 0,043 | 0,049 |
| **1** | **40** | **1.5** | 0,048 | 0,044 | 0,047 | 0,048 | 0,042 | 0,047 | 0,048 | 0,044 | 0,047 |
| **2** | **40** | **1.5** | 0,031 | 0,044 | 0,055 | 0,035 | 0,042 | 0,059 | 0,031 | 0,044 | 0,055 |
| **4** | **40** | **1.5** | 0,031 | 0,044 | 0,069 | 0,041 | 0,042 | 0,084\* | 0,031 | 0,044 | 0,069 |
| **0.5** | **40** | **2** | 0,098\* | 0,043 | 0,048 | 0,092\* | 0,041 | 0,049 | 0,098\* | 0,043 | 0,048 |
| **1** | **40** | **2** | 0,048 | 0,044 | 0,047 | 0,048 | 0,042 | 0,047 | 0,048 | 0,044 | 0,047 |
| **2** | **40** | **2** | 0,019\* | 0,045 | 0,054 | 0,022\* | 0,042 | 0,059 | 0,019\* | 0,045 | 0,054 |
| **4** | **40** | **2** | 0,014\* | 0,045 | 0,069 | 0,020\* | 0,043 | 0,084\* | 0,014\* | 0,045 | 0,069 |
| **0.5** | **50** | **0.5** | 0,031 | 0,044 | 0,054 | 0,036 | 0,042 | 0,054 | 0,031 | 0,044 | 0,054 |
| **1** | **50** | **0.5** | 0,048 | 0,043 | 0,046 | 0,048 | 0,042 | 0,046 | 0,048 | 0,043 | 0,046 |
| **2** | **50** | **0.5** | 0,111\* | 0,042 | 0,051 | 0,115\* | 0,042 | 0,056 | 0,111\* | 0,042 | 0,051 |
| **4** | **50** | **0.5** | 0,187\* | 0,043 | 0,063 | 0,206\* | 0,042 | 0,077\* | 0,187\* | 0,043 | 0,063 |
| **0.5** | **50** | **1** | 0,052 | 0,044 | 0,051 | 0,053 | 0,043 | 0,052 | 0,052 | 0,044 | 0,051 |
| **1** | **50** | **1** | 0,048 | 0,045 | 0,047 | 0,047 | 0,043 | 0,047 | 0,048 | 0,045 | 0,047 |
| **2** | **50** | **1** | 0,057 | 0,044 | 0,055 | 0,061 | 0,043 | 0,060 | 0,057 | 0,044 | 0,055 |
| **4** | **50** | **1** | 0,073 | 0,044 | 0,069 | 0,089\* | 0,043 | 0,083\* | 0,073 | 0,044 | 0,069 |
| **0.5** | **50** | **1.5** | 0,076\* | 0,044 | 0,050 | 0,072 | 0,043 | 0,051 | 0,076\* | 0,044 | 0,050 |
| **1** | **50** | **1.5** | 0,048 | 0,045 | 0,047 | 0,048 | 0,043 | 0,047 | 0,048 | 0,045 | 0,047 |
| **2** | **50** | **1.5** | 0,032 | 0,045 | 0,056 | 0,036 | 0,044 | 0,060 | 0,032 | 0,045 | 0,056 |
| **4** | **50** | **1.5** | 0,031 | 0,045 | 0,070 | 0,042 | 0,044 | 0,086\* | 0,031 | 0,045 | 0,070 |
| **0.5** | **50** | **2** | 0,099\* | 0,044 | 0,049 | 0,093\* | 0,043 | 0,050 | 0,099\* | 0,044 | 0,049 |
| **1** | **50** | **2** | 0,049 | 0,045 | 0,048 | 0,048 | 0,043 | 0,047 | 0,049 | 0,045 | 0,048 |
| **2** | **50** | **2** | 0,020\* | 0,046 | 0,055 | 0,022\* | 0,044 | 0,059 | 0,020\* | 0,046 | 0,055 |
| **4** | **50** | **2** | 0,014\* | 0,046 | 0,071 | 0,020\* | 0,044 | 0,085\* | 0,014\* | 0,046 | 0,071 |
| **0.5** | **100** | **0.5** | 0,032 | 0,047 | 0,055 | 0,037 | 0,046 | 0,056 | 0,032 | 0,047 | 0,055 |
| **1** | **100** | **0.5** | 0,049 | 0,046 | 0,048 | 0,049 | 0,045 | 0,049 | 0,049 | 0,046 | 0,048 |
| **2** | **100** | **0.5** | 0,116\* | 0,045 | 0,056 | 0,119\* | 0,045 | 0,062 | 0,116\* | 0,045 | 0,056 |
| **4** | **100** | **0.5** | 0,189\* | 0,046 | 0,070 | 0,206\* | 0,045 | 0,085\* | 0,189\* | 0,046 | 0,070 |
| **0.5** | **100** | **1** | 0,053 | 0,047 | 0,053 | 0,055 | 0,047 | 0,054 | 0,053 | 0,047 | 0,053 |
| **1** | **100** | **1** | 0,049 | 0,047 | 0,048 | 0,049 | 0,046 | 0,049 | 0,049 | 0,047 | 0,048 |
| **2** | **100** | **1** | 0,058 | 0,047 | 0,057 | 0,063 | 0,046 | 0,063 | 0,058 | 0,047 | 0,057 |
| **4** | **100** | **1** | 0,075 | 0,047 | 0,073 | 0,091\* | 0,046 | 0,089\* | 0,075 | 0,047 | 0,073 |
| **0.5** | **100** | **1.5** | 0,076\* | 0,047 | 0,051 | 0,074 | 0,046 | 0,053 | 0,076\* | 0,047 | 0,051 |
| **1** | **100** | **1.5** | 0,049 | 0,048 | 0,049 | 0,049 | 0,046 | 0,049 | 0,049 | 0,048 | 0,049 |
| **2** | **100** | **1.5** | 0,032 | 0,048 | 0,057 | 0,037 | 0,047 | 0,062 | 0,032 | 0,048 | 0,057 |
| **4** | **100** | **1.5** | 0,032 | 0,048 | 0,072 | 0,043 | 0,047 | 0,087\* | 0,032 | 0,048 | 0,072 |
| **0.5** | **100** | **2** | 0,100\* | 0,047 | 0,050 | 0,094\* | 0,046 | 0,052 | 0,100\* | 0,047 | 0,050 |
| **1** | **100** | **2** | 0,049 | 0,047 | 0,048 | 0,049 | 0,046 | 0,048 | 0,049 | 0,047 | 0,048 |
| **2** | **100** | **2** | 0,020\* | 0,048 | 0,056 | 0,022\* | 0,047 | 0,061 | 0,020\* | 0,048 | 0,056 |
| **4** | **100** | **2** | 0,015\* | 0,048 | 0,072 | 0,021\* | 0,047 | 0,087\* | 0,015\* | 0,048 | 0,072 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table A3.4a  *Real alpha risk, when nominal alpha risk = 5%, two groups are compared and samples are extracted from normal right skewed distributions.* | | | | | |
|  |  |  | **Test** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | Welch | B-F |
| **0.5** | **20** | **0.5** | 0,023\* | 0,048 | 0,048 |
| **1** | **20** | **0.5** | 0,049 | 0,053 | 0,053 |
| **2** | **20** | **0.5** | 0,119\* | 0,065 | 0,065 |
| **4** | **20** | **0.5** | 0,172\* | 0,067 | 0,067 |
| **0.5** | **20** | **1** | 0,056 | 0,054 | 0,054 |
| **1** | **20** | **1** | 0,049 | 0,048 | 0,048 |
| **2** | **20** | **1** | 0,056 | 0,054 | 0,054 |
| **4** | **20** | **1** | 0,063 | 0,058 | 0,058 |
| **0.5** | **20** | **1.5** | 0,087\* | 0,056 | 0,056 |
| **1** | **20** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **20** | **1.5** | 0,032 | 0,051 | 0,051 |
| **4** | **20** | **1.5** | 0,028 | 0,055 | 0,055 |
| **0.5** | **20** | **2** | 0,114\* | 0,057 | 0,057 |
| **1** | **20** | **2** | 0,050 | 0,052 | 0,052 |
| **2** | **20** | **2** | 0,020\* | 0,050 | 0,050 |
| **4** | **20** | **2** | 0,013\* | 0,053 | 0,053 |
| **0.5** | **30** | **0.5** | 0,021\* | 0,050 | 0,050 |
| **1** | **30** | **0.5** | 0,050 | 0,052 | 0,052 |
| **2** | **30** | **0.5** | 0,117\* | 0,060 | 0,060 |
| **4** | **30** | **0.5** | 0,164\* | 0,062 | 0,062 |
| **0.5** | **30** | **1** | 0,054 | 0,053 | 0,053 |
| **1** | **30** | **1** | 0,050 | 0,049 | 0,049 |
| **2** | **30** | **1** | 0,054 | 0,052 | 0,052 |
| **4** | **30** | **1** | 0,059 | 0,056 | 0,056 |
| **0.5** | **30** | **1.5** | 0,086\* | 0,054 | 0,054 |
| **1** | **30** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **30** | **1.5** | 0,030 | 0,051 | 0,051 |
| **4** | **30** | **1.5** | 0,025 | 0,053 | 0,053 |
| **0.5** | **30** | **2** | 0,112\* | 0,054 | 0,054 |
| **1** | **30** | **2** | 0,050 | 0,051 | 0,051 |
| **2** | **30** | **2** | 0,019\* | 0,050 | 0,050 |
| **4** | **30** | **2** | 0,011\* | 0,052 | 0,052 |
| **0.5** | **40** | **0.5** | 0,020\* | 0,050 | 0,050 |
| **1** | **40** | **0.5** | 0,050 | 0,052 | 0,052 |
| **2** | **40** | **0.5** | 0,115\* | 0,057 | 0,057 |
| **4** | **40** | **0.5** | 0,160\* | 0,059 | 0,059 |
| **0.5** | **40** | **1** | 0,053 | 0,052 | 0,052 |
| **1** | **40** | **1** | 0,050 | 0,049 | 0,049 |
| **2** | **40** | **1** | 0,054 | 0,052 | 0,052 |
| **4** | **40** | **1** | 0,057 | 0,054 | 0,054 |
| **0.5** | **40** | **1.5** | 0,085\* | 0,053 | 0,053 |
| **1** | **40** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **40** | **1.5** | 0,029 | 0,051 | 0,051 |
| **4** | **40** | **1.5** | 0,023\* | 0,052 | 0,052 |
| **0.5** | **40** | **2** | 0,112\* | 0,054 | 0,054 |
| **1** | **40** | **2** | 0,050 | 0,051 | 0,051 |
| **2** | **40** | **2** | 0,018\* | 0,049 | 0,049 |
| **4** | **40** | **2** | 0,011\* | 0,052 | 0,052 |
| **0.5** | **50** | **0.5** | 0,019\* | 0,050 | 0,050 |
| **1** | **50** | **0.5** | 0,050 | 0,051 | 0,051 |
| **2** | **50** | **0.5** | 0,113\* | 0,056 | 0,056 |
| **4** | **50** | **0.5** | 0,158\* | 0,057 | 0,057 |
| **0.5** | **50** | **1** | 0,052 | 0,052 | 0,052 |
| **1** | **50** | **1** | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **1** | 0,053 | 0,052 | 0,052 |
| **4** | **50** | **1** | 0,056 | 0,054 | 0,054 |
| **0.5** | **50** | **1.5** | 0,085\* | 0,052 | 0,052 |
| **1** | **50** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **1.5** | 0,029 | 0,050 | 0,050 |
| **4** | **50** | **1.5** | 0,023\* | 0,052 | 0,052 |
| **0.5** | **50** | **2** | 0,111\* | 0,053 | 0,053 |
| **1** | **50** | **2** | 0,050 | 0,051 | 0,051 |
| **2** | **50** | **2** | 0,018\* | 0,050 | 0,050 |
| **4** | **50** | **2** | 0,010\* | 0,052 | 0,052 |
| **0.5** | **100** | **0.5** | 0,018\* | 0,050 | 0,050 |
| **1** | **100** | **0.5** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **0.5** | 0,112\* | 0,053 | 0,053 |
| **4** | **100** | **0.5** | 0,153\* | 0,054 | 0,054 |
| **0.5** | **100** | **1** | 0,051 | 0,051 | 0,051 |
| **1** | **100** | **1** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **1** | 0,051 | 0,050 | 0,050 |
| **4** | **100** | **1** | 0,053 | 0,052 | 0,052 |
| **0.5** | **100** | **1.5** | 0,084\* | 0,052 | 0,052 |
| **1** | **100** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **1.5** | 0,028 | 0,050 | 0,050 |
| **4** | **100** | **1.5** | 0,021\* | 0,051 | 0,051 |
| **0.5** | **100** | **2** | 0,111\* | 0,052 | 0,052 |
| **1** | **100** | **2** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **100** | **2** | 0,009\* | 0,051 | 0,051 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A3.4b  *Real alpha risk, when nominal alpha risk = 5%, three, four or five groups are compared and samples are extracted from normal right skewed distributions.* | | | | | | | | | | | |
|  |  |  | **Number of compared groups** | | | | | | | | |
|  |  |  | **3 groups** | | | **4 groups** | | | **5 groups** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test |
| **0.5** | **20** | **0.5** | 0,034 | 0,052 | 0,055 | 0,038 | 0,055 | 0,055 | 0,040 | 0,058 | 0,054 |
| **1** | **20** | **0.5** | 0,049 | 0,056 | 0,049 | 0,049 | 0,059 | 0,048 | 0,049 | 0,061 | 0,048 |
| **2** | **20** | **0.5** | 0,125\* | 0,062 | 0,070 | 0,127\* | 0,065 | 0,073 | 0,125\* | 0,066 | 0,073 |
| **4** | **20** | **0.5** | 0,207\* | 0,065 | 0,084\* | 0,225\* | 0,067 | 0,095\* | 0,235\* | 0,069 | 0,102\* |
| **0.5** | **20** | **1** | 0,056 | 0,057 | 0,053 | 0,056 | 0,060 | 0,054 | 0,055 | 0,062 | 0,053 |
| **1** | **20** | **1** | 0,049 | 0,051 | 0,048 | 0,049 | 0,055 | 0,048 | 0,049 | 0,057 | 0,048 |
| **2** | **20** | **1** | 0,065 | 0,054 | 0,062 | 0,070 | 0,057 | 0,066 | 0,072 | 0,059 | 0,068 |
| **4** | **20** | **1** | 0,088\* | 0,057 | 0,079\* | 0,103\* | 0,059 | 0,091\* | 0,113\* | 0,061 | 0,099\* |
| **0.5** | **20** | **1.5** | 0,080\* | 0,060 | 0,053 | 0,076\* | 0,063 | 0,053 | 0,072 | 0,065 | 0,052 |
| **1** | **20** | **1.5** | 0,049 | 0,052 | 0,049 | 0,049 | 0,055 | 0,048 | 0,050 | 0,058 | 0,049 |
| **2** | **20** | **1.5** | 0,037 | 0,052 | 0,058 | 0,041 | 0,055 | 0,063 | 0,044 | 0,057 | 0,065 |
| **4** | **20** | **1.5** | 0,042 | 0,054 | 0,076\* | 0,052 | 0,056 | 0,089\* | 0,059 | 0,058 | 0,098\* |
| **0.5** | **20** | **2** | 0,104\* | 0,063 | 0,053 | 0,096\* | 0,066 | 0,052 | 0,091\* | 0,068 | 0,052 |
| **1** | **20** | **2** | 0,049 | 0,054 | 0,049 | 0,049 | 0,056 | 0,048 | 0,050 | 0,059 | 0,049 |
| **2** | **20** | **2** | 0,023\* | 0,051 | 0,056 | 0,026 | 0,054 | 0,061 | 0,028 | 0,056 | 0,064 |
| **4** | **20** | **2** | 0,022\* | 0,053 | 0,074 | 0,028 | 0,055 | 0,088\* | 0,033 | 0,056 | 0,097\* |
| **0.5** | **30** | **0.5** | 0,034 | 0,052 | 0,056 | 0,038 | 0,054 | 0,056 | 0,040 | 0,056 | 0,056 |
| **1** | **30** | **0.5** | 0,049 | 0,054 | 0,049 | 0,049 | 0,056 | 0,049 | 0,050 | 0,058 | 0,049 |
| **2** | **30** | **0.5** | 0,123\* | 0,059 | 0,067 | 0,125\* | 0,060 | 0,070 | 0,124\* | 0,061 | 0,072 |
| **4** | **30** | **0.5** | 0,200\* | 0,061 | 0,081\* | 0,218\* | 0,062 | 0,093\* | 0,228\* | 0,063 | 0,101\* |
| **0.5** | **30** | **1** | 0,055 | 0,055 | 0,054 | 0,056 | 0,057 | 0,055 | 0,055 | 0,059 | 0,054 |
| **1** | **30** | **1** | 0,050 | 0,051 | 0,049 | 0,050 | 0,054 | 0,049 | 0,049 | 0,055 | 0,049 |
| **2** | **30** | **1** | 0,063 | 0,053 | 0,061 | 0,068 | 0,055 | 0,065 | 0,070 | 0,056 | 0,068 |
| **4** | **30** | **1** | 0,084\* | 0,055 | 0,077\* | 0,099\* | 0,056 | 0,091\* | 0,109\* | 0,058 | 0,100\* |
| **0.5** | **30** | **1.5** | 0,079\* | 0,057 | 0,053 | 0,076\* | 0,059 | 0,054 | 0,072 | 0,061 | 0,053 |
| **1** | **30** | **1.5** | 0,049 | 0,052 | 0,049 | 0,049 | 0,053 | 0,049 | 0,050 | 0,056 | 0,050 |
| **2** | **30** | **1.5** | 0,036 | 0,052 | 0,059 | 0,040 | 0,053 | 0,063 | 0,043 | 0,055 | 0,065 |
| **4** | **30** | **1.5** | 0,039 | 0,053 | 0,075 | 0,049 | 0,054 | 0,089\* | 0,057 | 0,056 | 0,099\* |
| **0.5** | **30** | **2** | 0,103\* | 0,058 | 0,053 | 0,097\* | 0,061 | 0,053 | 0,091\* | 0,063 | 0,053 |
| **1** | **30** | **2** | 0,050 | 0,053 | 0,050 | 0,050 | 0,055 | 0,049 | 0,050 | 0,056 | 0,049 |
| **2** | **30** | **2** | 0,022\* | 0,051 | 0,057 | 0,025 | 0,052 | 0,061 | 0,027 | 0,054 | 0,064 |
| **4** | **30** | **2** | 0,019\* | 0,052 | 0,074 | 0,026 | 0,053 | 0,088\* | 0,031 | 0,055 | 0,098\* |
| **0.5** | **40** | **0.5** | 0,034 | 0,052 | 0,056 | 0,038 | 0,053 | 0,057 | 0,040 | 0,055 | 0,056 |
| **1** | **40** | **0.5** | 0,049 | 0,053 | 0,050 | 0,049 | 0,055 | 0,049 | 0,050 | 0,056 | 0,049 |
| **2** | **40** | **0.5** | 0,123\* | 0,057 | 0,065 | 0,124\* | 0,057 | 0,069 | 0,123\* | 0,059 | 0,071 |
| **4** | **40** | **0.5** | 0,197\* | 0,058 | 0,080\* | 0,214\* | 0,059 | 0,093\* | 0,224\* | 0,060 | 0,101\* |
| **0.5** | **40** | **1** | 0,055 | 0,054 | 0,054 | 0,056 | 0,055 | 0,055 | 0,055 | 0,056 | 0,055 |
| **1** | **40** | **1** | 0,049 | 0,051 | 0,049 | 0,049 | 0,053 | 0,049 | 0,050 | 0,054 | 0,049 |
| **2** | **40** | **1** | 0,062 | 0,053 | 0,061 | 0,067 | 0,053 | 0,065 | 0,070 | 0,055 | 0,068 |
| **4** | **40** | **1** | 0,082\* | 0,054 | 0,077\* | 0,097\* | 0,055 | 0,091\* | 0,108\* | 0,056 | 0,101\* |
| **0.5** | **40** | **1.5** | 0,079\* | 0,056 | 0,054 | 0,075 | 0,057 | 0,053 | 0,072 | 0,058 | 0,053 |
| **1** | **40** | **1.5** | 0,049 | 0,051 | 0,049 | 0,049 | 0,053 | 0,049 | 0,050 | 0,054 | 0,049 |
| **2** | **40** | **1.5** | 0,035 | 0,051 | 0,058 | 0,039 | 0,052 | 0,063 | 0,042 | 0,054 | 0,066 |
| **4** | **40** | **1.5** | 0,038 | 0,052 | 0,075 | 0,048 | 0,053 | 0,089\* | 0,055 | 0,054 | 0,099\* |
| **0.5** | **40** | **2** | 0,102\* | 0,057 | 0,053 | 0,096\* | 0,058 | 0,053 | 0,091\* | 0,060 | 0,053 |
| **1** | **40** | **2** | 0,050 | 0,052 | 0,050 | 0,050 | 0,054 | 0,050 | 0,050 | 0,055 | 0,049 |
| **2** | **40** | **2** | 0,022\* | 0,051 | 0,057 | 0,024\* | 0,052 | 0,061 | 0,027 | 0,054 | 0,064 |
| **4** | **40** | **2** | 0,019\* | 0,052 | 0,074 | 0,025 | 0,052 | 0,088\* | 0,030 | 0,054 | 0,098\* |
| **0.5** | **50** | **0.5** | 0,034 | 0,051 | 0,057 | 0,038 | 0,053 | 0,057 | 0,040 | 0,054 | 0,056 |
| **1** | **50** | **0.5** | 0,050 | 0,053 | 0,050 | 0,050 | 0,054 | 0,049 | 0,049 | 0,055 | 0,049 |
| **2** | **50** | **0.5** | 0,122\* | 0,055 | 0,064 | 0,123\* | 0,056 | 0,069 | 0,123\* | 0,057 | 0,071 |
| **4** | **50** | **0.5** | 0,193\* | 0,057 | 0,079\* | 0,212\* | 0,057 | 0,092\* | 0,222\* | 0,058 | 0,101\* |
| **0.5** | **50** | **1** | 0,055 | 0,053 | 0,054 | 0,056 | 0,054 | 0,055 | 0,055 | 0,055 | 0,055 |
| **1** | **50** | **1** | 0,050 | 0,051 | 0,050 | 0,049 | 0,052 | 0,049 | 0,050 | 0,054 | 0,050 |
| **2** | **50** | **1** | 0,062 | 0,052 | 0,060 | 0,067 | 0,053 | 0,065 | 0,069 | 0,054 | 0,068 |
| **4** | **50** | **1** | 0,080\* | 0,053 | 0,076\* | 0,096\* | 0,054 | 0,091\* | 0,107\* | 0,055 | 0,101\* |
| **0.5** | **50** | **1.5** | 0,078\* | 0,054 | 0,053 | 0,075 | 0,056 | 0,054 | 0,073 | 0,057 | 0,054 |
| **1** | **50** | **1.5** | 0,050 | 0,051 | 0,050 | 0,049 | 0,052 | 0,049 | 0,050 | 0,053 | 0,049 |
| **2** | **50** | **1.5** | 0,035 | 0,051 | 0,058 | 0,039 | 0,052 | 0,063 | 0,042 | 0,053 | 0,066 |
| **4** | **50** | **1.5** | 0,037 | 0,052 | 0,075 | 0,047 | 0,053 | 0,089\* | 0,054 | 0,054 | 0,099\* |
| **0.5** | **50** | **2** | 0,102\* | 0,055 | 0,052 | 0,095\* | 0,057 | 0,053 | 0,091\* | 0,058 | 0,053 |
| **1** | **50** | **2** | 0,050 | 0,052 | 0,050 | 0,050 | 0,053 | 0,050 | 0,050 | 0,054 | 0,049 |
| **2** | **50** | **2** | 0,021\* | 0,051 | 0,057 | 0,024\* | 0,052 | 0,061 | 0,026 | 0,053 | 0,064 |
| **4** | **50** | **2** | 0,018\* | 0,051 | 0,073 | 0,024\* | 0,052 | 0,088\* | 0,030 | 0,053 | 0,098\* |
| **0.5** | **100** | **0.5** | 0,033 | 0,051 | 0,057 | 0,038 | 0,051 | 0,058 | 0,040 | 0,052 | 0,057 |
| **1** | **100** | **0.5** | 0,050 | 0,052 | 0,050 | 0,050 | 0,052 | 0,050 | 0,050 | 0,053 | 0,050 |
| **2** | **100** | **0.5** | 0,121\* | 0,053 | 0,063 | 0,123\* | 0,053 | 0,068 | 0,123\* | 0,054 | 0,071 |
| **4** | **100** | **0.5** | 0,190\* | 0,054 | 0,078\* | 0,208\* | 0,053 | 0,092\* | 0,219\* | 0,054 | 0,103\* |
| **0.5** | **100** | **1** | 0,055 | 0,052 | 0,055 | 0,056 | 0,052 | 0,055 | 0,055 | 0,052 | 0,055 |
| **1** | **100** | **1** | 0,050 | 0,050 | 0,050 | 0,049 | 0,051 | 0,049 | 0,050 | 0,052 | 0,050 |
| **2** | **100** | **1** | 0,061 | 0,051 | 0,060 | 0,066 | 0,051 | 0,065 | 0,068 | 0,052 | 0,068 |
| **4** | **100** | **1** | 0,078\* | 0,052 | 0,076\* | 0,094\* | 0,052 | 0,091\* | 0,104\* | 0,053 | 0,101\* |
| **0.5** | **100** | **1.5** | 0,078\* | 0,052 | 0,053 | 0,075 | 0,053 | 0,054 | 0,072 | 0,053 | 0,054 |
| **1** | **100** | **1.5** | 0,050 | 0,051 | 0,050 | 0,050 | 0,052 | 0,050 | 0,050 | 0,051 | 0,050 |
| **2** | **100** | **1.5** | 0,034 | 0,050 | 0,058 | 0,038 | 0,051 | 0,063 | 0,041 | 0,051 | 0,066 |
| **4** | **100** | **1.5** | 0,035 | 0,051 | 0,074 | 0,046 | 0,051 | 0,089\* | 0,053 | 0,051 | 0,100\* |
| **0.5** | **100** | **2** | 0,101\* | 0,053 | 0,052 | 0,096\* | 0,053 | 0,053 | 0,091\* | 0,054 | 0,054 |
| **1** | **100** | **2** | 0,050 | 0,051 | 0,050 | 0,050 | 0,051 | 0,050 | 0,050 | 0,052 | 0,050 |
| **2** | **100** | **2** | 0,020\* | 0,051 | 0,057 | 0,024\* | 0,051 | 0,062 | 0,026 | 0,051 | 0,064 |
| **4** | **100** | **2** | 0,017\* | 0,051 | 0,073 | 0,023\* | 0,051 | 0,088\* | 0,028 | 0,052 | 0,098\* |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table A3.5a  *Real alpha risk, when nominal alpha risk = 5%, two groups are compared, one sample is extracted from normal right skewed distribution, and one sample is extracted from a left skewed distribution.* | | | | | |
|  |  |  | **Test** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | Welch | B-F |
| **0.5** | **20** | **0.5** | 0,026 | 0,056 | 0,056 |
| **1** | **20** | **0.5** | 0,057 | 0,060 | 0,060 |
| **2** | **20** | **0.5** | 0,122\* | 0,066 | 0,066 |
| **4** | **20** | **0.5** | 0,172\* | 0,067 | 0,067 |
| **0.5** | **20** | **1** | 0,059 | 0,057 | 0,057 |
| **1** | **20** | **1** | 0,055 | 0,055 | 0,055 |
| **2** | **20** | **1** | 0,059 | 0,056 | 0,056 |
| **4** | **20** | **1** | 0,064 | 0,059 | 0,059 |
| **0.5** | **20** | **1.5** | 0,089\* | 0,057 | 0,057 |
| **1** | **20** | **1.5** | 0,054 | 0,055 | 0,055 |
| **2** | **20** | **1.5** | 0,034 | 0,054 | 0,054 |
| **4** | **20** | **1.5** | 0,028 | 0,056 | 0,056 |
| **0.5** | **20** | **2** | 0,116\* | 0,058 | 0,058 |
| **1** | **20** | **2** | 0,054 | 0,055 | 0,055 |
| **2** | **20** | **2** | 0,021\* | 0,053 | 0,053 |
| **4** | **20** | **2** | 0,013\* | 0,055 | 0,055 |
| **0.5** | **30** | **0.5** | 0,023\* | 0,054 | 0,054 |
| **1** | **30** | **0.5** | 0,054 | 0,056 | 0,056 |
| **2** | **30** | **0.5** | 0,118\* | 0,061 | 0,061 |
| **4** | **30** | **0.5** | 0,164\* | 0,062 | 0,062 |
| **0.5** | **30** | **1** | 0,057 | 0,055 | 0,055 |
| **1** | **30** | **1** | 0,054 | 0,054 | 0,054 |
| **2** | **30** | **1** | 0,056 | 0,054 | 0,054 |
| **4** | **30** | **1** | 0,060 | 0,056 | 0,056 |
| **0.5** | **30** | **1.5** | 0,087\* | 0,055 | 0,055 |
| **1** | **30** | **1.5** | 0,053 | 0,053 | 0,053 |
| **2** | **30** | **1.5** | 0,032 | 0,053 | 0,053 |
| **4** | **30** | **1.5** | 0,025 | 0,054 | 0,054 |
| **0.5** | **30** | **2** | 0,114\* | 0,055 | 0,055 |
| **1** | **30** | **2** | 0,052 | 0,053 | 0,053 |
| **2** | **30** | **2** | 0,019\* | 0,052 | 0,052 |
| **4** | **30** | **2** | 0,011\* | 0,053 | 0,053 |
| **0.5** | **40** | **0.5** | 0,021\* | 0,053 | 0,053 |
| **1** | **40** | **0.5** | 0,054 | 0,055 | 0,055 |
| **2** | **40** | **0.5** | 0,116\* | 0,058 | 0,058 |
| **4** | **40** | **0.5** | 0,160\* | 0,059 | 0,059 |
| **0.5** | **40** | **1** | 0,055 | 0,053 | 0,053 |
| **1** | **40** | **1** | 0,053 | 0,053 | 0,053 |
| **2** | **40** | **1** | 0,055 | 0,054 | 0,054 |
| **4** | **40** | **1** | 0,057 | 0,055 | 0,055 |
| **0.5** | **40** | **1.5** | 0,086\* | 0,054 | 0,054 |
| **1** | **40** | **1.5** | 0,052 | 0,052 | 0,052 |
| **2** | **40** | **1.5** | 0,031 | 0,053 | 0,053 |
| **4** | **40** | **1.5** | 0,024\* | 0,053 | 0,053 |
| **0.5** | **40** | **2** | 0,112\* | 0,054 | 0,054 |
| **1** | **40** | **2** | 0,052 | 0,053 | 0,053 |
| **2** | **40** | **2** | 0,019\* | 0,052 | 0,052 |
| **4** | **40** | **2** | 0,011\* | 0,052 | 0,052 |
| **0.5** | **50** | **0.5** | 0,020\* | 0,053 | 0,053 |
| **1** | **50** | **0.5** | 0,053 | 0,054 | 0,054 |
| **2** | **50** | **0.5** | 0,114\* | 0,056 | 0,056 |
| **4** | **50** | **0.5** | 0,158\* | 0,058 | 0,058 |
| **0.5** | **50** | **1** | 0,054 | 0,053 | 0,053 |
| **1** | **50** | **1** | 0,052 | 0,052 | 0,052 |
| **2** | **50** | **1** | 0,054 | 0,053 | 0,053 |
| **4** | **50** | **1** | 0,056 | 0,054 | 0,054 |
| **0.5** | **50** | **1.5** | 0,085\* | 0,053 | 0,053 |
| **1** | **50** | **1.5** | 0,052 | 0,052 | 0,052 |
| **2** | **50** | **1.5** | 0,030 | 0,052 | 0,052 |
| **4** | **50** | **1.5** | 0,023\* | 0,052 | 0,052 |
| **0.5** | **50** | **2** | 0,112\* | 0,053 | 0,053 |
| **1** | **50** | **2** | 0,052 | 0,052 | 0,052 |
| **2** | **50** | **2** | 0,018\* | 0,051 | 0,051 |
| **4** | **50** | **2** | 0,010\* | 0,052 | 0,052 |
| **0.5** | **100** | **0.5** | 0,019\* | 0,052 | 0,052 |
| **1** | **100** | **0.5** | 0,051 | 0,052 | 0,052 |
| **2** | **100** | **0.5** | 0,112\* | 0,054 | 0,054 |
| **4** | **100** | **0.5** | 0,153\* | 0,054 | 0,054 |
| **0.5** | **100** | **1** | 0,052 | 0,052 | 0,052 |
| **1** | **100** | **1** | 0,051 | 0,051 | 0,051 |
| **2** | **100** | **1** | 0,052 | 0,052 | 0,052 |
| **4** | **100** | **1** | 0,053 | 0,051 | 0,051 |
| **0.5** | **100** | **1.5** | 0,084\* | 0,052 | 0,052 |
| **1** | **100** | **1.5** | 0,051 | 0,051 | 0,051 |
| **2** | **100** | **1.5** | 0,028 | 0,051 | 0,051 |
| **4** | **100** | **1.5** | 0,021\* | 0,051 | 0,051 |
| **0.5** | **100** | **2** | 0,111\* | 0,052 | 0,052 |
| **1** | **100** | **2** | 0,051 | 0,051 | 0,051 |
| **2** | **100** | **2** | 0,017\* | 0,051 | 0,051 |
| **4** | **100** | **2** | 0,009\* | 0,050 | 0,050 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A3.5b  *Real alpha risk, when nominal alpha risk = 5%, three, four or five groups are compared, all samples exept the last one are extracted from normal right skewed distribution, and the last one is extracted from a left skewed distribution.* | | | | | | | | | | | |
|  |  |  | **Number of compared groups** | | | | | | | | | |
|  |  |  | **3 groups** | | | **4 groups** | | | **5 groups** | | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test | |
| **0.5** | **20** | **0.5** | 0,034 | 0,062 | 0,056 | 0,038 | 0,067 | 0,056 | 0,040 | 0,071 | 0,055 | |
| **1** | **20** | **0.5** | 0,052 | 0,065 | 0,053 | 0,050 | 0,069 | 0,051 | 0,050 | 0,072 | 0,050 | |
| **2** | **20** | **0.5** | 0,128\* | 0,068 | 0,072 | 0,127\* | 0,070 | 0,074 | 0,126\* | 0,072 | 0,075 | |
| **4** | **20** | **0.5** | 0,207\* | 0,067 | 0,084\* | 0,225\* | 0,070 | 0,094\* | 0,234\* | 0,071 | 0,101\* | |
| **0.5** | **20** | **1** | 0,057 | 0,063 | 0,055 | 0,056 | 0,066 | 0,054 | 0,056 | 0,070 | 0,054 | |
| **1** | **20** | **1** | 0,053 | 0,060 | 0,052 | 0,051 | 0,063 | 0,050 | 0,050 | 0,066 | 0,049 | |
| **2** | **20** | **1** | 0,067 | 0,059 | 0,064 | 0,071 | 0,062 | 0,067 | 0,073 | 0,064 | 0,069 | |
| **4** | **20** | **1** | 0,088\* | 0,059 | 0,079\* | 0,103\* | 0,062 | 0,091\* | 0,113\* | 0,063 | 0,099\* | |
| **0.5** | **20** | **1.5** | 0,082\* | 0,063 | 0,054 | 0,077\* | 0,068 | 0,053 | 0,073 | 0,071 | 0,052 | |
| **1** | **20** | **1.5** | 0,053 | 0,059 | 0,052 | 0,051 | 0,062 | 0,050 | 0,051 | 0,065 | 0,049 | |
| **2** | **20** | **1.5** | 0,039 | 0,057 | 0,060 | 0,043 | 0,060 | 0,065 | 0,045 | 0,062 | 0,067 | |
| **4** | **20** | **1.5** | 0,042 | 0,057 | 0,076\* | 0,052 | 0,058 | 0,089\* | 0,060 | 0,061 | 0,098\* | |
| **0.5** | **20** | **2** | 0,106\* | 0,064 | 0,054 | 0,097\* | 0,069 | 0,053 | 0,092\* | 0,072 | 0,052 | |
| **1** | **20** | **2** | 0,052 | 0,059 | 0,051 | 0,052 | 0,063 | 0,050 | 0,051 | 0,065 | 0,049 | |
| **2** | **20** | **2** | 0,024\* | 0,056 | 0,058 | 0,027 | 0,059 | 0,063 | 0,029 | 0,062 | 0,065 | |
| **4** | **20** | **2** | 0,021\* | 0,055 | 0,074 | 0,028 | 0,057 | 0,088\* | 0,033 | 0,060 | 0,097\* | |
| **0.5** | **30** | **0.5** | 0,034 | 0,059 | 0,057 | 0,038 | 0,063 | 0,057 | 0,040 | 0,065 | 0,056 | |
| **1** | **30** | **0.5** | 0,052 | 0,060 | 0,053 | 0,050 | 0,063 | 0,051 | 0,050 | 0,066 | 0,050 | |
| **2** | **30** | **0.5** | 0,125\* | 0,062 | 0,068 | 0,126\* | 0,064 | 0,072 | 0,125\* | 0,065 | 0,073 | |
| **4** | **30** | **0.5** | 0,200\* | 0,062 | 0,081\* | 0,218\* | 0,064 | 0,093\* | 0,228\* | 0,065 | 0,101\* | |
| **0.5** | **30** | **1** | 0,056 | 0,059 | 0,055 | 0,056 | 0,061 | 0,054 | 0,056 | 0,064 | 0,054 | |
| **1** | **30** | **1** | 0,052 | 0,057 | 0,051 | 0,051 | 0,059 | 0,050 | 0,051 | 0,062 | 0,050 | |
| **2** | **30** | **1** | 0,065 | 0,057 | 0,062 | 0,069 | 0,058 | 0,067 | 0,071 | 0,060 | 0,069 | |
| **4** | **30** | **1** | 0,083\* | 0,056 | 0,077\* | 0,100\* | 0,058 | 0,091\* | 0,110\* | 0,060 | 0,101\* | |
| **0.5** | **30** | **1.5** | 0,080\* | 0,059 | 0,054 | 0,076\* | 0,063 | 0,054 | 0,073 | 0,065 | 0,053 | |
| **1** | **30** | **1.5** | 0,052 | 0,056 | 0,051 | 0,051 | 0,059 | 0,051 | 0,051 | 0,061 | 0,050 | |
| **2** | **30** | **1.5** | 0,037 | 0,055 | 0,060 | 0,041 | 0,057 | 0,064 | 0,044 | 0,059 | 0,067 | |
| **4** | **30** | **1.5** | 0,039 | 0,055 | 0,075 | 0,049 | 0,056 | 0,089\* | 0,057 | 0,058 | 0,099\* | |
| **0.5** | **30** | **2** | 0,104\* | 0,060 | 0,053 | 0,097\* | 0,063 | 0,053 | 0,092\* | 0,066 | 0,053 | |
| **1** | **30** | **2** | 0,052 | 0,056 | 0,051 | 0,051 | 0,059 | 0,050 | 0,051 | 0,061 | 0,050 | |
| **2** | **30** | **2** | 0,023\* | 0,055 | 0,058 | 0,026 | 0,056 | 0,062 | 0,028 | 0,058 | 0,065 | |
| **4** | **30** | **2** | 0,020\* | 0,054 | 0,074 | 0,026 | 0,055 | 0,088\* | 0,031 | 0,057 | 0,098\* | |
| **0.5** | **40** | **0.5** | 0,034 | 0,057 | 0,057 | 0,038 | 0,060 | 0,057 | 0,040 | 0,062 | 0,056 | |
| **1** | **40** | **0.5** | 0,051 | 0,058 | 0,052 | 0,050 | 0,060 | 0,051 | 0,050 | 0,062 | 0,050 | |
| **2** | **40** | **0.5** | 0,123\* | 0,059 | 0,066 | 0,125\* | 0,061 | 0,070 | 0,124\* | 0,062 | 0,072 | |
| **4** | **40** | **0.5** | 0,196\* | 0,060 | 0,080\* | 0,214\* | 0,061 | 0,092\* | 0,225\* | 0,061 | 0,101\* | |
| **0.5** | **40** | **1** | 0,056 | 0,057 | 0,055 | 0,056 | 0,059 | 0,055 | 0,055 | 0,060 | 0,055 | |
| **1** | **40** | **1** | 0,052 | 0,055 | 0,051 | 0,051 | 0,057 | 0,050 | 0,050 | 0,059 | 0,050 | |
| **2** | **40** | **1** | 0,063 | 0,055 | 0,062 | 0,068 | 0,057 | 0,066 | 0,071 | 0,058 | 0,069 | |
| **4** | **40** | **1** | 0,082\* | 0,055 | 0,077\* | 0,097\* | 0,056 | 0,090\* | 0,108\* | 0,057 | 0,100\* | |
| **0.5** | **40** | **1.5** | 0,080\* | 0,057 | 0,054 | 0,076\* | 0,059 | 0,054 | 0,073 | 0,061 | 0,054 | |
| **1** | **40** | **1.5** | 0,052 | 0,055 | 0,051 | 0,051 | 0,057 | 0,050 | 0,050 | 0,058 | 0,049 | |
| **2** | **40** | **1.5** | 0,036 | 0,054 | 0,059 | 0,040 | 0,055 | 0,064 | 0,043 | 0,057 | 0,067 | |
| **4** | **40** | **1.5** | 0,038 | 0,054 | 0,075 | 0,048 | 0,055 | 0,089\* | 0,056 | 0,056 | 0,099\* | |
| **0.5** | **40** | **2** | 0,103\* | 0,057 | 0,053 | 0,096\* | 0,060 | 0,053 | 0,090\* | 0,061 | 0,053 | |
| **1** | **40** | **2** | 0,051 | 0,055 | 0,051 | 0,051 | 0,057 | 0,050 | 0,050 | 0,058 | 0,050 | |
| **2** | **40** | **2** | 0,022\* | 0,053 | 0,058 | 0,025 | 0,055 | 0,062 | 0,027 | 0,056 | 0,065 | |
| **4** | **40** | **2** | 0,019\* | 0,053 | 0,074 | 0,025 | 0,054 | 0,088\* | 0,030 | 0,055 | 0,098\* | |
| **0.5** | **50** | **0.5** | 0,034 | 0,056 | 0,057 | 0,038 | 0,057 | 0,057 | 0,040 | 0,060 | 0,057 | |
| **1** | **50** | **0.5** | 0,051 | 0,057 | 0,052 | 0,050 | 0,058 | 0,051 | 0,050 | 0,060 | 0,050 | |
| **2** | **50** | **0.5** | 0,123\* | 0,057 | 0,065 | 0,124\* | 0,059 | 0,069 | 0,123\* | 0,060 | 0,071 | |
| **4** | **50** | **0.5** | 0,194\* | 0,058 | 0,079\* | 0,213\* | 0,059 | 0,093\* | 0,223\* | 0,059 | 0,101\* | |
| **0.5** | **50** | **1** | 0,055 | 0,055 | 0,055 | 0,056 | 0,057 | 0,055 | 0,056 | 0,059 | 0,055 | |
| **1** | **50** | **1** | 0,051 | 0,054 | 0,051 | 0,050 | 0,056 | 0,050 | 0,050 | 0,057 | 0,050 | |
| **2** | **50** | **1** | 0,063 | 0,054 | 0,061 | 0,068 | 0,056 | 0,066 | 0,070 | 0,057 | 0,069 | |
| **4** | **50** | **1** | 0,080\* | 0,054 | 0,076\* | 0,096\* | 0,055 | 0,091\* | 0,107\* | 0,055 | 0,101\* | |
| **0.5** | **50** | **1.5** | 0,080\* | 0,056 | 0,054 | 0,075 | 0,058 | 0,054 | 0,073 | 0,059 | 0,054 | |
| **1** | **50** | **1.5** | 0,051 | 0,054 | 0,051 | 0,051 | 0,056 | 0,050 | 0,050 | 0,057 | 0,050 | |
| **2** | **50** | **1.5** | 0,036 | 0,053 | 0,059 | 0,040 | 0,055 | 0,064 | 0,042 | 0,056 | 0,066 | |
| **4** | **50** | **1.5** | 0,037 | 0,053 | 0,075 | 0,047 | 0,054 | 0,089\* | 0,055 | 0,055 | 0,100\* | |
| **0.5** | **50** | **2** | 0,103\* | 0,056 | 0,053 | 0,096\* | 0,058 | 0,053 | 0,091\* | 0,059 | 0,053 | |
| **1** | **50** | **2** | 0,051 | 0,054 | 0,051 | 0,050 | 0,055 | 0,050 | 0,050 | 0,057 | 0,050 | |
| **2** | **50** | **2** | 0,022\* | 0,053 | 0,058 | 0,025 | 0,054 | 0,062 | 0,027 | 0,055 | 0,065 | |
| **4** | **50** | **2** | 0,018\* | 0,053 | 0,073 | 0,024\* | 0,053 | 0,088\* | 0,029 | 0,055 | 0,098\* | |
| **0.5** | **100** | **0.5** | 0,034 | 0,053 | 0,057 | 0,038 | 0,054 | 0,058 | 0,040 | 0,055 | 0,057 | |
| **1** | **100** | **0.5** | 0,050 | 0,054 | 0,051 | 0,050 | 0,054 | 0,050 | 0,050 | 0,055 | 0,050 | |
| **2** | **100** | **0.5** | 0,120\* | 0,054 | 0,063 | 0,123\* | 0,054 | 0,068 | 0,122\* | 0,055 | 0,071 | |
| **4** | **100** | **0.5** | 0,189\* | 0,054 | 0,078\* | 0,208\* | 0,054 | 0,092\* | 0,219\* | 0,054 | 0,103\* | |
| **0.5** | **100** | **1** | 0,055 | 0,053 | 0,054 | 0,056 | 0,054 | 0,056 | 0,056 | 0,054 | 0,055 | |
| **1** | **100** | **1** | 0,051 | 0,052 | 0,051 | 0,050 | 0,053 | 0,050 | 0,050 | 0,054 | 0,050 | |
| **2** | **100** | **1** | 0,061 | 0,052 | 0,060 | 0,066 | 0,053 | 0,066 | 0,069 | 0,054 | 0,068 | |
| **4** | **100** | **1** | 0,077\* | 0,052 | 0,075 | 0,094\* | 0,053 | 0,091\* | 0,104\* | 0,053 | 0,101\* | |
| **0.5** | **100** | **1.5** | 0,078\* | 0,053 | 0,053 | 0,075 | 0,054 | 0,054 | 0,073 | 0,055 | 0,054 | |
| **1** | **100** | **1.5** | 0,050 | 0,052 | 0,050 | 0,050 | 0,053 | 0,050 | 0,050 | 0,054 | 0,050 | |
| **2** | **100** | **1.5** | 0,034 | 0,051 | 0,059 | 0,038 | 0,052 | 0,063 | 0,041 | 0,052 | 0,066 | |
| **4** | **100** | **1.5** | 0,035 | 0,052 | 0,074 | 0,046 | 0,052 | 0,089\* | 0,053 | 0,053 | 0,100\* | |
| **0.5** | **100** | **2** | 0,102\* | 0,053 | 0,053 | 0,095\* | 0,054 | 0,053 | 0,091\* | 0,055 | 0,054 | |
| **1** | **100** | **2** | 0,051 | 0,052 | 0,051 | 0,050 | 0,053 | 0,050 | 0,050 | 0,053 | 0,050 | |
| **2** | **100** | **2** | 0,021\* | 0,051 | 0,057 | 0,024\* | 0,052 | 0,062 | 0,026 | 0,053 | 0,065 | |
| **4** | **100** | **2** | 0,017\* | 0,051 | 0,073 | 0,023\* | 0,052 | 0,088\* | 0,028 | 0,052 | 0,098\* | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table A3.6a  *Real alpha risk, when nominal alpha risk = 5%, two groups are compared, one sample is extracted from a chi-square distribution, and one sample is extracted from a right skewed distribution.* | | | | | |
|  |  |  | **Test** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | Welch | B-F |
| **0.5** | **20** | **0.5** | 0,034 | 0,050 | 0,050 |
| **1** | **20** | **0.5** | 0,054 | 0,050 | 0,050 |
| **2** | **20** | **0.5** | 0,121\* | 0,064 | 0,064 |
| **4** | **20** | **0.5** | 0,172\* | 0,068 | 0,068 |
| **0.5** | **20** | **1** | 0,065 | 0,063 | 0,063 |
| **1** | **20** | **1** | 0,049 | 0,047 | 0,047 |
| **2** | **20** | **1** | 0,056 | 0,053 | 0,053 |
| **4** | **20** | **1** | 0,063 | 0,058 | 0,058 |
| **0.5** | **20** | **1.5** | 0,093\* | 0,069 | 0,069 |
| **1** | **20** | **1.5** | 0,047 | 0,052 | 0,052 |
| **2** | **20** | **1.5** | 0,031 | 0,050 | 0,050 |
| **4** | **20** | **1.5** | 0,027 | 0,055 | 0,055 |
| **0.5** | **20** | **2** | 0,118\* | 0,071 | 0,071 |
| **1** | **20** | **2** | 0,046 | 0,055 | 0,055 |
| **2** | **20** | **2** | 0,019\* | 0,048 | 0,048 |
| **4** | **20** | **2** | 0,013\* | 0,053 | 0,053 |
| **0.5** | **30** | **0.5** | 0,030 | 0,051 | 0,051 |
| **1** | **30** | **0.5** | 0,053 | 0,050 | 0,050 |
| **2** | **30** | **0.5** | 0,117\* | 0,059 | 0,059 |
| **4** | **30** | **0.5** | 0,164\* | 0,062 | 0,062 |
| **0.5** | **30** | **1** | 0,061 | 0,060 | 0,060 |
| **1** | **30** | **1** | 0,049 | 0,049 | 0,049 |
| **2** | **30** | **1** | 0,054 | 0,052 | 0,052 |
| **4** | **30** | **1** | 0,059 | 0,056 | 0,056 |
| **0.5** | **30** | **1.5** | 0,090\* | 0,063 | 0,063 |
| **1** | **30** | **1.5** | 0,048 | 0,052 | 0,052 |
| **2** | **30** | **1.5** | 0,029 | 0,050 | 0,050 |
| **4** | **30** | **1.5** | 0,025 | 0,053 | 0,053 |
| **0.5** | **30** | **2** | 0,116\* | 0,066 | 0,066 |
| **1** | **30** | **2** | 0,047 | 0,054 | 0,054 |
| **2** | **30** | **2** | 0,018\* | 0,049 | 0,049 |
| **4** | **30** | **2** | 0,011\* | 0,052 | 0,052 |
| **0.5** | **40** | **0.5** | 0,027 | 0,051 | 0,051 |
| **1** | **40** | **0.5** | 0,052 | 0,050 | 0,050 |
| **2** | **40** | **0.5** | 0,115\* | 0,056 | 0,056 |
| **4** | **40** | **0.5** | 0,161\* | 0,060 | 0,060 |
| **0.5** | **40** | **1** | 0,058 | 0,057 | 0,057 |
| **1** | **40** | **1** | 0,050 | 0,049 | 0,049 |
| **2** | **40** | **1** | 0,053 | 0,051 | 0,051 |
| **4** | **40** | **1** | 0,057 | 0,054 | 0,054 |
| **0.5** | **40** | **1.5** | 0,089\* | 0,060 | 0,060 |
| **1** | **40** | **1.5** | 0,049 | 0,051 | 0,051 |
| **2** | **40** | **1.5** | 0,029 | 0,050 | 0,050 |
| **4** | **40** | **1.5** | 0,023\* | 0,053 | 0,053 |
| **0.5** | **40** | **2** | 0,114\* | 0,062 | 0,062 |
| **1** | **40** | **2** | 0,048 | 0,053 | 0,053 |
| **2** | **40** | **2** | 0,018\* | 0,050 | 0,050 |
| **4** | **40** | **2** | 0,011\* | 0,052 | 0,052 |
| **0.5** | **50** | **0.5** | 0,025 | 0,051 | 0,051 |
| **1** | **50** | **0.5** | 0,052 | 0,050 | 0,050 |
| **2** | **50** | **0.5** | 0,115\* | 0,056 | 0,056 |
| **4** | **50** | **0.5** | 0,158\* | 0,058 | 0,058 |
| **0.5** | **50** | **1** | 0,057 | 0,056 | 0,056 |
| **1** | **50** | **1** | 0,050 | 0,049 | 0,049 |
| **2** | **50** | **1** | 0,052 | 0,051 | 0,051 |
| **4** | **50** | **1** | 0,056 | 0,053 | 0,053 |
| **0.5** | **50** | **1.5** | 0,088\* | 0,059 | 0,059 |
| **1** | **50** | **1.5** | 0,049 | 0,051 | 0,051 |
| **2** | **50** | **1.5** | 0,029 | 0,050 | 0,050 |
| **4** | **50** | **1.5** | 0,023\* | 0,052 | 0,052 |
| **0.5** | **50** | **2** | 0,113\* | 0,060 | 0,060 |
| **1** | **50** | **2** | 0,049 | 0,053 | 0,053 |
| **2** | **50** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **50** | **2** | 0,010\* | 0,051 | 0,051 |
| **0.5** | **100** | **0.5** | 0,021\* | 0,051 | 0,051 |
| **1** | **100** | **0.5** | 0,051 | 0,050 | 0,050 |
| **2** | **100** | **0.5** | 0,112\* | 0,053 | 0,053 |
| **4** | **100** | **0.5** | 0,153\* | 0,053 | 0,053 |
| **0.5** | **100** | **1** | 0,054 | 0,054 | 0,054 |
| **1** | **100** | **1** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **1** | 0,051 | 0,050 | 0,050 |
| **4** | **100** | **1** | 0,053 | 0,052 | 0,052 |
| **0.5** | **100** | **1.5** | 0,086\* | 0,055 | 0,055 |
| **1** | **100** | **1.5** | 0,049 | 0,051 | 0,051 |
| **2** | **100** | **1.5** | 0,028 | 0,050 | 0,050 |
| **4** | **100** | **1.5** | 0,021\* | 0,051 | 0,051 |
| **0.5** | **100** | **2** | 0,112\* | 0,055 | 0,055 |
| **1** | **100** | **2** | 0,049 | 0,051 | 0,051 |
| **2** | **100** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **100** | **2** | 0,009\* | 0,051 | 0,051 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A3.6b  *Real alpha risk, when nominal alpha risk = 5%, three, four or five groups are compared, all samples exept the last one are extracted from a chi-square distribution, and the last one is extracted from a right skewed distribution.* | | | | | | | | | | | |
|  |  |  | **Number of compared groups** | | | | | | | | |
|  |  |  | **3 groups** | | | **4 groups** | | | **5 groups** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test |
| **0.5** | **20** | **0.5** | 0,034 | 0,056 | 0,052 | 0,036 | 0,063 | 0,051 | 0,037 | 0,068 | 0,049 |
| **1** | **20** | **0.5** | 0,050 | 0,053 | 0,045 | 0,050 | 0,059 | 0,045 | 0,049 | 0,064 | 0,045 |
| **2** | **20** | **0.5** | 0,128\* | 0,060 | 0,070 | 0,128\* | 0,063 | 0,071 | 0,126\* | 0,067 | 0,072 |
| **4** | **20** | **0.5** | 0,208\* | 0,062 | 0,084\* | 0,226\* | 0,066 | 0,094\* | 0,235\* | 0,070 | 0,101\* |
| **0.5** | **20** | **1** | 0,057 | 0,072 | 0,054 | 0,054 | 0,078\* | 0,050 | 0,053 | 0,083\* | 0,049 |
| **1** | **20** | **1** | 0,048 | 0,053 | 0,046 | 0,047 | 0,058 | 0,045 | 0,047 | 0,064 | 0,045 |
| **2** | **20** | **1** | 0,065 | 0,052 | 0,061 | 0,069 | 0,056 | 0,065 | 0,072 | 0,062 | 0,067 |
| **4** | **20** | **1** | 0,088\* | 0,054 | 0,078\* | 0,103\* | 0,058 | 0,091\* | 0,113\* | 0,063 | 0,099\* |
| **0.5** | **20** | **1.5** | 0,081\* | 0,080\* | 0,055 | 0,074 | 0,087\* | 0,050 | 0,070 | 0,093\* | 0,048 |
| **1** | **20** | **1.5** | 0,046 | 0,056 | 0,047 | 0,046 | 0,063 | 0,046 | 0,046 | 0,068 | 0,045 |
| **2** | **20** | **1.5** | 0,037 | 0,050 | 0,057 | 0,041 | 0,056 | 0,062 | 0,043 | 0,061 | 0,064 |
| **4** | **20** | **1.5** | 0,042 | 0,051 | 0,076\* | 0,051 | 0,055 | 0,088\* | 0,060 | 0,061 | 0,098\* |
| **0.5** | **20** | **2** | 0,104\* | 0,085\* | 0,056 | 0,095\* | 0,094\* | 0,050 | 0,088\* | 0,101\* | 0,049 |
| **1** | **20** | **2** | 0,046 | 0,062 | 0,049 | 0,046 | 0,067 | 0,046 | 0,046 | 0,072 | 0,046 |
| **2** | **20** | **2** | 0,023\* | 0,050 | 0,055 | 0,025 | 0,055 | 0,060 | 0,028 | 0,061 | 0,062 |
| **4** | **20** | **2** | 0,021\* | 0,050 | 0,074 | 0,028 | 0,054 | 0,087\* | 0,033 | 0,060 | 0,096\* |
| **0.5** | **30** | **0.5** | 0,034 | 0,056 | 0,055 | 0,036 | 0,061 | 0,053 | 0,038 | 0,065 | 0,052 |
| **1** | **30** | **0.5** | 0,050 | 0,053 | 0,047 | 0,049 | 0,057 | 0,046 | 0,049 | 0,061 | 0,047 |
| **2** | **30** | **0.5** | 0,125\* | 0,057 | 0,067 | 0,126\* | 0,060 | 0,070 | 0,125\* | 0,064 | 0,072 |
| **4** | **30** | **0.5** | 0,201\* | 0,058 | 0,081\* | 0,219\* | 0,062 | 0,092\* | 0,229\* | 0,066 | 0,101\* |
| **0.5** | **30** | **1** | 0,057 | 0,067 | 0,055 | 0,054 | 0,071 | 0,052 | 0,054 | 0,075 | 0,052 |
| **1** | **30** | **1** | 0,049 | 0,053 | 0,048 | 0,049 | 0,058 | 0,047 | 0,048 | 0,062 | 0,046 |
| **2** | **30** | **1** | 0,063 | 0,052 | 0,060 | 0,068 | 0,055 | 0,065 | 0,070 | 0,060 | 0,067 |
| **4** | **30** | **1** | 0,083\* | 0,053 | 0,077\* | 0,099\* | 0,057 | 0,091\* | 0,110\* | 0,060 | 0,100\* |
| **0.5** | **30** | **1.5** | 0,080\* | 0,073 | 0,055 | 0,074 | 0,079\* | 0,052 | 0,071 | 0,083\* | 0,051 |
| **1** | **30** | **1.5** | 0,047 | 0,056 | 0,048 | 0,047 | 0,060 | 0,047 | 0,048 | 0,064 | 0,047 |
| **2** | **30** | **1.5** | 0,035 | 0,051 | 0,058 | 0,040 | 0,055 | 0,063 | 0,042 | 0,059 | 0,065 |
| **4** | **30** | **1.5** | 0,039 | 0,051 | 0,075 | 0,049 | 0,054 | 0,089\* | 0,057 | 0,058 | 0,099\* |
| **0.5** | **30** | **2** | 0,103\* | 0,076\* | 0,055 | 0,095\* | 0,084\* | 0,052 | 0,089\* | 0,089\* | 0,051 |
| **1** | **30** | **2** | 0,047 | 0,059 | 0,049 | 0,047 | 0,064 | 0,048 | 0,047 | 0,067 | 0,047 |
| **2** | **30** | **2** | 0,022\* | 0,051 | 0,056 | 0,025 | 0,055 | 0,061 | 0,027 | 0,059 | 0,063 |
| **4** | **30** | **2** | 0,019\* | 0,050 | 0,074 | 0,026 | 0,054 | 0,088\* | 0,031 | 0,058 | 0,098\* |
| **0.5** | **40** | **0.5** | 0,034 | 0,056 | 0,056 | 0,037 | 0,059 | 0,055 | 0,038 | 0,063 | 0,054 |
| **1** | **40** | **0.5** | 0,050 | 0,052 | 0,048 | 0,049 | 0,056 | 0,047 | 0,049 | 0,060 | 0,048 |
| **2** | **40** | **0.5** | 0,124\* | 0,055 | 0,065 | 0,125\* | 0,058 | 0,069 | 0,124\* | 0,061 | 0,071 |
| **4** | **40** | **0.5** | 0,197\* | 0,057 | 0,080\* | 0,215\* | 0,059 | 0,092\* | 0,225\* | 0,063 | 0,101\* |
| **0.5** | **40** | **1** | 0,056 | 0,063 | 0,055 | 0,055 | 0,067 | 0,053 | 0,054 | 0,071 | 0,053 |
| **1** | **40** | **1** | 0,049 | 0,053 | 0,048 | 0,048 | 0,056 | 0,048 | 0,049 | 0,060 | 0,048 |
| **2** | **40** | **1** | 0,062 | 0,051 | 0,060 | 0,067 | 0,055 | 0,065 | 0,070 | 0,058 | 0,067 |
| **4** | **40** | **1** | 0,082\* | 0,052 | 0,077\* | 0,097\* | 0,055 | 0,091\* | 0,108\* | 0,059 | 0,101\* |
| **0.5** | **40** | **1.5** | 0,080\* | 0,069 | 0,055 | 0,075 | 0,073 | 0,053 | 0,072 | 0,077\* | 0,052 |
| **1** | **40** | **1.5** | 0,048 | 0,055 | 0,049 | 0,048 | 0,059 | 0,048 | 0,048 | 0,062 | 0,048 |
| **2** | **40** | **1.5** | 0,035 | 0,051 | 0,058 | 0,039 | 0,054 | 0,062 | 0,042 | 0,058 | 0,066 |
| **4** | **40** | **1.5** | 0,038 | 0,051 | 0,075 | 0,048 | 0,054 | 0,089\* | 0,056 | 0,058 | 0,099\* |
| **0.5** | **40** | **2** | 0,103\* | 0,071 | 0,055 | 0,095\* | 0,077\* | 0,052 | 0,090\* | 0,081\* | 0,052 |
| **1** | **40** | **2** | 0,048 | 0,058 | 0,050 | 0,048 | 0,062 | 0,049 | 0,048 | 0,065 | 0,048 |
| **2** | **40** | **2** | 0,021\* | 0,051 | 0,057 | 0,024\* | 0,054 | 0,061 | 0,026 | 0,058 | 0,064 |
| **4** | **40** | **2** | 0,018\* | 0,050 | 0,073 | 0,025 | 0,053 | 0,088\* | 0,030 | 0,057 | 0,097\* |
| **0.5** | **50** | **0.5** | 0,034 | 0,054 | 0,056 | 0,037 | 0,058 | 0,056 | 0,039 | 0,061 | 0,055 |
| **1** | **50** | **0.5** | 0,050 | 0,052 | 0,049 | 0,049 | 0,055 | 0,048 | 0,050 | 0,058 | 0,048 |
| **2** | **50** | **0.5** | 0,123\* | 0,054 | 0,064 | 0,124\* | 0,057 | 0,069 | 0,123\* | 0,059 | 0,071 |
| **4** | **50** | **0.5** | 0,194\* | 0,055 | 0,079\* | 0,213\* | 0,058 | 0,092\* | 0,223\* | 0,060 | 0,101\* |
| **0.5** | **50** | **1** | 0,056 | 0,061 | 0,055 | 0,055 | 0,065 | 0,054 | 0,054 | 0,068 | 0,053 |
| **1** | **50** | **1** | 0,049 | 0,052 | 0,048 | 0,049 | 0,055 | 0,048 | 0,049 | 0,059 | 0,048 |
| **2** | **50** | **1** | 0,061 | 0,051 | 0,060 | 0,067 | 0,054 | 0,065 | 0,069 | 0,057 | 0,067 |
| **4** | **50** | **1** | 0,080\* | 0,052 | 0,077\* | 0,095\* | 0,054 | 0,090\* | 0,107\* | 0,057 | 0,100\* |
| **0.5** | **50** | **1.5** | 0,079\* | 0,065 | 0,055 | 0,074 | 0,069 | 0,053 | 0,071 | 0,073 | 0,053 |
| **1** | **50** | **1.5** | 0,048 | 0,054 | 0,049 | 0,048 | 0,057 | 0,049 | 0,048 | 0,061 | 0,048 |
| **2** | **50** | **1.5** | 0,034 | 0,051 | 0,058 | 0,039 | 0,054 | 0,063 | 0,041 | 0,056 | 0,065 |
| **4** | **50** | **1.5** | 0,036 | 0,051 | 0,074 | 0,047 | 0,053 | 0,089\* | 0,055 | 0,057 | 0,100\* |
| **0.5** | **50** | **2** | 0,104\* | 0,068 | 0,055 | 0,095\* | 0,072 | 0,053 | 0,089\* | 0,076\* | 0,052 |
| **1** | **50** | **2** | 0,048 | 0,056 | 0,050 | 0,048 | 0,059 | 0,049 | 0,048 | 0,063 | 0,049 |
| **2** | **50** | **2** | 0,021\* | 0,051 | 0,056 | 0,024\* | 0,054 | 0,061 | 0,026 | 0,057 | 0,064 |
| **4** | **50** | **2** | 0,018\* | 0,050 | 0,073 | 0,024\* | 0,053 | 0,088\* | 0,029 | 0,056 | 0,098\* |
| **0.5** | **100** | **0.5** | 0,034 | 0,053 | 0,057 | 0,037 | 0,055 | 0,057 | 0,040 | 0,057 | 0,056 |
| **1** | **100** | **0.5** | 0,050 | 0,051 | 0,049 | 0,050 | 0,053 | 0,049 | 0,050 | 0,055 | 0,049 |
| **2** | **100** | **0.5** | 0,120\* | 0,052 | 0,063 | 0,123\* | 0,054 | 0,068 | 0,123\* | 0,055 | 0,071 |
| **4** | **100** | **0.5** | 0,190\* | 0,053 | 0,078\* | 0,208\* | 0,054 | 0,092\* | 0,219\* | 0,056 | 0,102\* |
| **0.5** | **100** | **1** | 0,055 | 0,057 | 0,055 | 0,055 | 0,058 | 0,055 | 0,055 | 0,060 | 0,055 |
| **1** | **100** | **1** | 0,050 | 0,052 | 0,050 | 0,049 | 0,053 | 0,049 | 0,049 | 0,055 | 0,049 |
| **2** | **100** | **1** | 0,061 | 0,050 | 0,060 | 0,066 | 0,052 | 0,065 | 0,069 | 0,054 | 0,068 |
| **4** | **100** | **1** | 0,078\* | 0,051 | 0,076\* | 0,093\* | 0,052 | 0,091\* | 0,104\* | 0,054 | 0,101\* |
| **0.5** | **100** | **1.5** | 0,079\* | 0,059 | 0,054 | 0,075 | 0,061 | 0,054 | 0,072 | 0,063 | 0,054 |
| **1** | **100** | **1.5** | 0,049 | 0,052 | 0,049 | 0,049 | 0,055 | 0,050 | 0,049 | 0,056 | 0,049 |
| **2** | **100** | **1.5** | 0,033 | 0,050 | 0,058 | 0,038 | 0,052 | 0,063 | 0,041 | 0,054 | 0,066 |
| **4** | **100** | **1.5** | 0,035 | 0,050 | 0,074 | 0,045 | 0,052 | 0,089\* | 0,053 | 0,054 | 0,100\* |
| **0.5** | **100** | **2** | 0,102\* | 0,059 | 0,053 | 0,095\* | 0,062 | 0,053 | 0,090\* | 0,064 | 0,053 |
| **1** | **100** | **2** | 0,049 | 0,054 | 0,050 | 0,049 | 0,055 | 0,050 | 0,049 | 0,057 | 0,050 |
| **2** | **100** | **2** | 0,021\* | 0,051 | 0,057 | 0,023\* | 0,052 | 0,061 | 0,026 | 0,054 | 0,064 |
| **4** | **100** | **2** | 0,017\* | 0,050 | 0,073 | 0,023\* | 0,052 | 0,088\* | 0,028 | 0,053 | 0,098\* |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table A3.7a  *Real alpha risk, when nominal alpha risk = 5%, two groups are compared, one sample is extracted from a chi-square distribution, and one sample is extracted from a left skewed distribution.* | | | | | |
|  |  |  | **Test** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | Welch | B-F |
| **0.5** | **20** | **0.5** | 0,039 | 0,064 | 0,064 |
| **1** | **20** | **0.5** | 0,068 | 0,063 | 0,063 |
| **2** | **20** | **0.5** | 0,126\* | 0,066 | 0,066 |
| **4** | **20** | **0.5** | 0,173\* | 0,067 | 0,067 |
| **0.5** | **20** | **1** | 0,070 | 0,068 | 0,068 |
| **1** | **20** | **1** | 0,060 | 0,060 | 0,060 |
| **2** | **20** | **1** | 0,061 | 0,058 | 0,058 |
| **4** | **20** | **1** | 0,064 | 0,059 | 0,059 |
| **0.5** | **20** | **1.5** | 0,097\* | 0,071 | 0,071 |
| **1** | **20** | **1.5** | 0,056 | 0,060 | 0,060 |
| **2** | **20** | **1.5** | 0,035 | 0,056 | 0,056 |
| **4** | **20** | **1.5** | 0,028 | 0,056 | 0,056 |
| **0.5** | **20** | **2** | 0,121\* | 0,073 | 0,073 |
| **1** | **20** | **2** | 0,053 | 0,062 | 0,062 |
| **2** | **20** | **2** | 0,021\* | 0,056 | 0,056 |
| **4** | **20** | **2** | 0,013\* | 0,055 | 0,055 |
| **0.5** | **30** | **0.5** | 0,033 | 0,060 | 0,060 |
| **1** | **30** | **0.5** | 0,062 | 0,058 | 0,058 |
| **2** | **30** | **0.5** | 0,121\* | 0,061 | 0,061 |
| **4** | **30** | **0.5** | 0,164\* | 0,062 | 0,062 |
| **0.5** | **30** | **1** | 0,065 | 0,064 | 0,064 |
| **1** | **30** | **1** | 0,057 | 0,057 | 0,057 |
| **2** | **30** | **1** | 0,057 | 0,056 | 0,056 |
| **4** | **30** | **1** | 0,060 | 0,056 | 0,056 |
| **0.5** | **30** | **1.5** | 0,093\* | 0,066 | 0,066 |
| **1** | **30** | **1.5** | 0,054 | 0,057 | 0,057 |
| **2** | **30** | **1.5** | 0,032 | 0,054 | 0,054 |
| **4** | **30** | **1.5** | 0,025 | 0,054 | 0,054 |
| **0.5** | **30** | **2** | 0,118\* | 0,067 | 0,067 |
| **1** | **30** | **2** | 0,052 | 0,059 | 0,059 |
| **2** | **30** | **2** | 0,020\* | 0,054 | 0,054 |
| **4** | **30** | **2** | 0,012\* | 0,053 | 0,053 |
| **0.5** | **40** | **0.5** | 0,029 | 0,058 | 0,058 |
| **1** | **40** | **0.5** | 0,060 | 0,057 | 0,057 |
| **2** | **40** | **0.5** | 0,118\* | 0,058 | 0,058 |
| **4** | **40** | **0.5** | 0,161\* | 0,060 | 0,060 |
| **0.5** | **40** | **1** | 0,061 | 0,060 | 0,060 |
| **1** | **40** | **1** | 0,056 | 0,056 | 0,056 |
| **2** | **40** | **1** | 0,056 | 0,054 | 0,054 |
| **4** | **40** | **1** | 0,057 | 0,054 | 0,054 |
| **0.5** | **40** | **1.5** | 0,090\* | 0,062 | 0,062 |
| **1** | **40** | **1.5** | 0,053 | 0,056 | 0,056 |
| **2** | **40** | **1.5** | 0,031 | 0,053 | 0,053 |
| **4** | **40** | **1.5** | 0,024\* | 0,053 | 0,053 |
| **0.5** | **40** | **2** | 0,116\* | 0,063 | 0,063 |
| **1** | **40** | **2** | 0,052 | 0,057 | 0,057 |
| **2** | **40** | **2** | 0,019\* | 0,053 | 0,053 |
| **4** | **40** | **2** | 0,011\* | 0,052 | 0,052 |
| **0.5** | **50** | **0.5** | 0,027 | 0,057 | 0,057 |
| **1** | **50** | **0.5** | 0,059 | 0,056 | 0,056 |
| **2** | **50** | **0.5** | 0,116\* | 0,057 | 0,057 |
| **4** | **50** | **0.5** | 0,158\* | 0,058 | 0,058 |
| **0.5** | **50** | **1** | 0,059 | 0,059 | 0,059 |
| **1** | **50** | **1** | 0,055 | 0,054 | 0,054 |
| **2** | **50** | **1** | 0,054 | 0,053 | 0,053 |
| **4** | **50** | **1** | 0,056 | 0,054 | 0,054 |
| **0.5** | **50** | **1.5** | 0,090\* | 0,060 | 0,060 |
| **1** | **50** | **1.5** | 0,052 | 0,055 | 0,055 |
| **2** | **50** | **1.5** | 0,030 | 0,053 | 0,053 |
| **4** | **50** | **1.5** | 0,023\* | 0,053 | 0,053 |
| **0.5** | **50** | **2** | 0,115\* | 0,061 | 0,061 |
| **1** | **50** | **2** | 0,051 | 0,055 | 0,055 |
| **2** | **50** | **2** | 0,018\* | 0,052 | 0,052 |
| **4** | **50** | **2** | 0,010\* | 0,052 | 0,052 |
| **0.5** | **100** | **0.5** | 0,022\* | 0,054 | 0,054 |
| **1** | **100** | **0.5** | 0,054 | 0,053 | 0,053 |
| **2** | **100** | **0.5** | 0,113\* | 0,054 | 0,054 |
| **4** | **100** | **0.5** | 0,153\* | 0,054 | 0,054 |
| **0.5** | **100** | **1** | 0,055 | 0,055 | 0,055 |
| **1** | **100** | **1** | 0,053 | 0,053 | 0,053 |
| **2** | **100** | **1** | 0,052 | 0,051 | 0,051 |
| **4** | **100** | **1** | 0,053 | 0,052 | 0,052 |
| **0.5** | **100** | **1.5** | 0,086\* | 0,055 | 0,055 |
| **1** | **100** | **1.5** | 0,052 | 0,053 | 0,053 |
| **2** | **100** | **1.5** | 0,028 | 0,051 | 0,051 |
| **4** | **100** | **1.5** | 0,021\* | 0,052 | 0,052 |
| **0.5** | **100** | **2** | 0,113\* | 0,056 | 0,056 |
| **1** | **100** | **2** | 0,051 | 0,053 | 0,053 |
| **2** | **100** | **2** | 0,018\* | 0,052 | 0,052 |
| **4** | **100** | **2** | 0,009\* | 0,051 | 0,051 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A3.7b.  *Real alpha risk, when nominal alpha risk = 5%, three, four or five groups are compared, all samples exept the last one are extracted from a chi-square distribution, and the last one is extracted from a left skewed distribution.* | | | | | | | | | | | |
|  |  |  | **Number of compared groups** | | | | | | | | |
|  |  |  | **3 groups** | | | **4 groups** | | | **5 groups** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test |
| **0.5** | **20** | **0.5** | 0,035 | 0,076\* | 0,056 | 0,036 | 0,086\* | 0,051 | 0,037 | 0,094\* | 0,050 |
| **1** | **20** | **0.5** | 0,057 | 0,070 | 0,055 | 0,052 | 0,077\* | 0,050 | 0,050 | 0,083\* | 0,048 |
| **2** | **20** | **0.5** | 0,132\* | 0,068 | 0,072 | 0,130\* | 0,073 | 0,074 | 0,128\* | 0,078\* | 0,075 |
| **4** | **20** | **0.5** | 0,208\* | 0,067 | 0,084\* | 0,225\* | 0,071 | 0,095\* | 0,235\* | 0,076\* | 0,101\* |
| **0.5** | **20** | **1** | 0,060 | 0,082\* | 0,056 | 0,055 | 0,091\* | 0,051 | 0,053 | 0,098\* | 0,049 |
| **1** | **20** | **1** | 0,054 | 0,067 | 0,052 | 0,051 | 0,075 | 0,049 | 0,050 | 0,080\* | 0,047 |
| **2** | **20** | **1** | 0,068 | 0,061 | 0,064 | 0,072 | 0,067 | 0,068 | 0,074 | 0,072 | 0,069 |
| **4** | **20** | **1** | 0,088\* | 0,058 | 0,079\* | 0,104\* | 0,063 | 0,091\* | 0,114\* | 0,068 | 0,100\* |
| **0.5** | **20** | **1.5** | 0,084\* | 0,086\* | 0,056 | 0,075 | 0,096\* | 0,051 | 0,070 | 0,104\* | 0,049 |
| **1** | **20** | **1.5** | 0,053 | 0,069 | 0,053 | 0,050 | 0,076\* | 0,049 | 0,050 | 0,083\* | 0,048 |
| **2** | **20** | **1.5** | 0,040 | 0,059 | 0,061 | 0,043 | 0,065 | 0,065 | 0,045 | 0,070 | 0,067 |
| **4** | **20** | **1.5** | 0,042 | 0,056 | 0,077\* | 0,052 | 0,061 | 0,089\* | 0,060 | 0,066 | 0,098\* |
| **0.5** | **20** | **2** | 0,108\* | 0,090\* | 0,057 | 0,096\* | 0,100\* | 0,051 | 0,089\* | 0,108\* | 0,049 |
| **1** | **20** | **2** | 0,051 | 0,071 | 0,052 | 0,050 | 0,078\* | 0,049 | 0,049 | 0,084\* | 0,048 |
| **2** | **20** | **2** | 0,025 | 0,059 | 0,059 | 0,028 | 0,065 | 0,063 | 0,030 | 0,071 | 0,066 |
| **4** | **20** | **2** | 0,022\* | 0,055 | 0,075 | 0,028 | 0,059 | 0,088\* | 0,033 | 0,065 | 0,097\* |
| **0.5** | **30** | **0.5** | 0,035 | 0,070 | 0,057 | 0,036 | 0,077\* | 0,054 | 0,038 | 0,083\* | 0,052 |
| **1** | **30** | **0.5** | 0,054 | 0,064 | 0,053 | 0,051 | 0,070 | 0,050 | 0,050 | 0,075 | 0,049 |
| **2** | **30** | **0.5** | 0,127\* | 0,062 | 0,068 | 0,128\* | 0,067 | 0,072 | 0,126\* | 0,071 | 0,073 |
| **4** | **30** | **0.5** | 0,200\* | 0,062 | 0,081\* | 0,218\* | 0,065 | 0,093\* | 0,229\* | 0,069 | 0,101\* |
| **0.5** | **30** | **1** | 0,058 | 0,074 | 0,056 | 0,055 | 0,080\* | 0,053 | 0,054 | 0,087 | 0,052 |
| **1** | **30** | **1** | 0,053 | 0,063 | 0,052 | 0,050 | 0,068 | 0,049 | 0,050 | 0,073 | 0,048 |
| **2** | **30** | **1** | 0,066 | 0,058 | 0,063 | 0,070 | 0,062 | 0,067 | 0,072 | 0,067 | 0,069 |
| **4** | **30** | **1** | 0,084\* | 0,056 | 0,077\* | 0,100\* | 0,061 | 0,091\* | 0,110\* | 0,064 | 0,100\* |
| **0.5** | **30** | **1.5** | 0,082\* | 0,077\* | 0,056 | 0,075 | 0,084\* | 0,052 | 0,071 | 0,090\* | 0,051 |
| **1** | **30** | **1.5** | 0,052 | 0,064 | 0,052 | 0,050 | 0,070 | 0,050 | 0,049 | 0,074 | 0,048 |
| **2** | **30** | **1.5** | 0,038 | 0,057 | 0,061 | 0,042 | 0,062 | 0,065 | 0,044 | 0,066 | 0,067 |
| **4** | **30** | **1.5** | 0,039 | 0,054 | 0,075 | 0,049 | 0,058 | 0,089\* | 0,057 | 0,063 | 0,099\* |
| **0.5** | **30** | **2** | 0,105\* | 0,079\* | 0,055 | 0,096\* | 0,087\* | 0,052 | 0,090\* | 0,093\* | 0,051 |
| **1** | **30** | **2** | 0,051 | 0,066 | 0,052 | 0,050 | 0,072 | 0,050 | 0,049 | 0,076\* | 0,049 |
| **2** | **30** | **2** | 0,024\* | 0,057 | 0,059 | 0,026 | 0,062 | 0,063 | 0,028 | 0,066 | 0,065 |
| **4** | **30** | **2** | 0,020\* | 0,053 | 0,074 | 0,026 | 0,058 | 0,088\* | 0,031 | 0,062 | 0,098\* |
| **0.5** | **40** | **0.5** | 0,034 | 0,066 | 0,057 | 0,037 | 0,072 | 0,055 | 0,038 | 0,077\* | 0,054 |
| **1** | **40** | **0.5** | 0,054 | 0,061 | 0,053 | 0,051 | 0,066 | 0,050 | 0,050 | 0,070 | 0,049 |
| **2** | **40** | **0.5** | 0,125\* | 0,060 | 0,067 | 0,126\* | 0,064 | 0,071 | 0,125\* | 0,067 | 0,072 |
| **4** | **40** | **0.5** | 0,197\* | 0,059 | 0,080\* | 0,215\* | 0,062 | 0,093\* | 0,226\* | 0,065 | 0,101\* |
| **0.5** | **40** | **1** | 0,057 | 0,068 | 0,055 | 0,055 | 0,074 | 0,054 | 0,054 | 0,079\* | 0,053 |
| **1** | **40** | **1** | 0,053 | 0,060 | 0,052 | 0,050 | 0,065 | 0,050 | 0,050 | 0,069 | 0,049 |
| **2** | **40** | **1** | 0,064 | 0,057 | 0,063 | 0,068 | 0,060 | 0,066 | 0,071 | 0,064 | 0,069 |
| **4** | **40** | **1** | 0,082\* | 0,055 | 0,077\* | 0,098\* | 0,058 | 0,091\* | 0,108\* | 0,062 | 0,101\* |
| **0.5** | **40** | **1.5** | 0,081\* | 0,072 | 0,055 | 0,075 | 0,077\* | 0,053 | 0,071 | 0,082\* | 0,052 |
| **1** | **40** | **1.5** | 0,052 | 0,062 | 0,052 | 0,050 | 0,066 | 0,050 | 0,050 | 0,070 | 0,049 |
| **2** | **40** | **1.5** | 0,036 | 0,055 | 0,060 | 0,041 | 0,060 | 0,064 | 0,043 | 0,063 | 0,067 |
| **4** | **40** | **1.5** | 0,038 | 0,053 | 0,075 | 0,048 | 0,057 | 0,090\* | 0,057 | 0,060 | 0,100\* |
| **0.5** | **40** | **2** | 0,105\* | 0,073 | 0,055 | 0,096\* | 0,080\* | 0,053 | 0,090\* | 0,085\* | 0,052 |
| **1** | **40** | **2** | 0,051 | 0,063 | 0,052 | 0,050 | 0,068 | 0,050 | 0,049 | 0,072 | 0,049 |
| **2** | **40** | **2** | 0,023\* | 0,056 | 0,059 | 0,025 | 0,060 | 0,063 | 0,027 | 0,063 | 0,065 |
| **4** | **40** | **2** | 0,019\* | 0,052 | 0,074 | 0,025 | 0,056 | 0,088\* | 0,030 | 0,060 | 0,098\* |
| **0.5** | **50** | **0.5** | 0,034 | 0,064 | 0,058 | 0,037 | 0,068 | 0,056 | 0,039 | 0,073 | 0,055 |
| **1** | **50** | **0.5** | 0,053 | 0,060 | 0,052 | 0,050 | 0,064 | 0,050 | 0,050 | 0,067 | 0,050 |
| **2** | **50** | **0.5** | 0,124\* | 0,058 | 0,066 | 0,125\* | 0,061 | 0,070 | 0,124\* | 0,064 | 0,072 |
| **4** | **50** | **0.5** | 0,195\* | 0,057 | 0,079\* | 0,212\* | 0,060 | 0,092\* | 0,223\* | 0,063 | 0,101\* |
| **0.5** | **50** | **1** | 0,057 | 0,066 | 0,056 | 0,055 | 0,071 | 0,054 | 0,055 | 0,075 | 0,054 |
| **1** | **50** | **1** | 0,052 | 0,059 | 0,052 | 0,051 | 0,063 | 0,050 | 0,050 | 0,066 | 0,049 |
| **2** | **50** | **1** | 0,063 | 0,055 | 0,062 | 0,068 | 0,059 | 0,066 | 0,071 | 0,062 | 0,069 |
| **4** | **50** | **1** | 0,080\* | 0,054 | 0,076\* | 0,096\* | 0,057 | 0,091\* | 0,107\* | 0,060 | 0,101\* |
| **0.5** | **50** | **1.5** | 0,081\* | 0,068 | 0,055 | 0,076\* | 0,073 | 0,054 | 0,072 | 0,077\* | 0,053 |
| **1** | **50** | **1.5** | 0,051 | 0,060 | 0,052 | 0,050 | 0,063 | 0,050 | 0,050 | 0,067 | 0,049 |
| **2** | **50** | **1.5** | 0,036 | 0,055 | 0,060 | 0,040 | 0,058 | 0,064 | 0,043 | 0,061 | 0,067 |
| **4** | **50** | **1.5** | 0,037 | 0,053 | 0,075 | 0,047 | 0,056 | 0,090\* | 0,055 | 0,059 | 0,099\* |
| **0.5** | **50** | **2** | 0,104\* | 0,069 | 0,054 | 0,096\* | 0,075 | 0,053 | 0,090\* | 0,079\* | 0,052 |
| **1** | **50** | **2** | 0,050 | 0,060 | 0,051 | 0,050 | 0,065 | 0,050 | 0,050 | 0,068 | 0,049 |
| **2** | **50** | **2** | 0,022\* | 0,055 | 0,059 | 0,025 | 0,058 | 0,062 | 0,027 | 0,061 | 0,065 |
| **4** | **50** | **2** | 0,018\* | 0,052 | 0,073 | 0,024\* | 0,056 | 0,088\* | 0,029 | 0,059 | 0,098\* |
| **0.5** | **100** | **0.5** | 0,034 | 0,053 | 0,057 | 0,038 | 0,060 | 0,057 | 0,039 | 0,062 | 0,056 |
| **1** | **100** | **0.5** | 0,050 | 0,051 | 0,049 | 0,051 | 0,058 | 0,051 | 0,050 | 0,059 | 0,050 |
| **2** | **100** | **0.5** | 0,120\* | 0,052 | 0,063 | 0,123\* | 0,056 | 0,068 | 0,122\* | 0,058 | 0,071 |
| **4** | **100** | **0.5** | 0,190\* | 0,053 | 0,078\* | 0,208\* | 0,056 | 0,092\* | 0,219\* | 0,057 | 0,103\* |
| **0.5** | **100** | **1** | 0,055 | 0,057 | 0,055 | 0,055 | 0,061 | 0,055 | 0,055 | 0,063 | 0,055 |
| **1** | **100** | **1** | 0,050 | 0,052 | 0,050 | 0,050 | 0,057 | 0,050 | 0,050 | 0,059 | 0,050 |
| **2** | **100** | **1** | 0,061 | 0,050 | 0,060 | 0,067 | 0,055 | 0,066 | 0,069 | 0,056 | 0,068 |
| **4** | **100** | **1** | 0,078\* | 0,051 | 0,076\* | 0,093\* | 0,054 | 0,090\* | 0,104\* | 0,056 | 0,101\* |
| **0.5** | **100** | **1.5** | 0,079\* | 0,059 | 0,054 | 0,075 | 0,063 | 0,054 | 0,072 | 0,065 | 0,054 |
| **1** | **100** | **1.5** | 0,049 | 0,052 | 0,049 | 0,050 | 0,057 | 0,050 | 0,050 | 0,059 | 0,050 |
| **2** | **100** | **1.5** | 0,033 | 0,050 | 0,058 | 0,038 | 0,054 | 0,063 | 0,041 | 0,056 | 0,066 |
| **4** | **100** | **1.5** | 0,035 | 0,050 | 0,074 | 0,046 | 0,053 | 0,090\* | 0,054 | 0,055 | 0,101\* |
| **0.5** | **100** | **2** | 0,102\* | 0,059 | 0,053 | 0,096\* | 0,064 | 0,054 | 0,090\* | 0,066 | 0,053 |
| **1** | **100** | **2** | 0,049 | 0,054 | 0,050 | 0,050 | 0,059 | 0,051 | 0,050 | 0,060 | 0,050 |
| **2** | **100** | **2** | 0,021\* | 0,051 | 0,057 | 0,024\* | 0,054 | 0,062 | 0,026 | 0,057 | 0,065 |
| **4** | **100** | **2** | 0,017\* | 0,050 | 0,073 | 0,023\* | 0,053 | 0,089\* | 0,028 | 0,055 | 0,099\* |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table A3.8a.  *Real alpha risk, when nominal alpha risk = 5%, two groups are compared and extracted from double exponential distribution, where standard deviation is .* | | | | | |
|  |  |  | **Test** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | Welch | B-F |
| **0.5** | **20** | **0.5** | 0,018\* | 0,046 | 0,044 |
| **1** | **20** | **0.5** | 0,048 | 0,046 | 0,044 |
| **2** | **20** | **0.5** | 0,107\* | 0,044 | 0,044 |
| **4** | **20** | **0.5** | 0,159\* | 0,043 | 0,043 |
| **0.5** | **20** | **1** | 0,050 | 0,047 | 0,046 |
| **1** | **20** | **1** | 0,048 | 0,048 | 0,046 |
| **2** | **20** | **1** | 0,050 | 0,047 | 0,046 |
| **4** | **20** | **1** | 0,052 | 0,047 | 0,047 |
| **0.5** | **20** | **1.5** | 0,082\* | 0,047 | 0,046 |
| **1** | **20** | **1.5** | 0,049 | 0,048 | 0,047 |
| **2** | **20** | **1.5** | 0,027 | 0,048 | 0,047 |
| **4** | **20** | **1.5** | 0,020\* | 0,049 | 0,049 |
| **0.5** | **20** | **2** | 0,109\* | 0,047 | 0,046 |
| **1** | **20** | **2** | 0,049 | 0,049 | 0,047 |
| **2** | **20** | **2** | 0,017\* | 0,049 | 0,047 |
| **4** | **20** | **2** | 0,008\* | 0,049 | 0,049 |
| **0.5** | **30** | **0.5** | 0,018\* | 0,048 | 0,046 |
| **1** | **30** | **0.5** | 0,049 | 0,047 | 0,046 |
| **2** | **30** | **0.5** | 0,109\* | 0,046 | 0,045 |
| **4** | **30** | **0.5** | 0,156\* | 0,046 | 0,046 |
| **0.5** | **30** | **1** | 0,050 | 0,048 | 0,048 |
| **1** | **30** | **1** | 0,049 | 0,049 | 0,047 |
| **2** | **30** | **1** | 0,050 | 0,048 | 0,047 |
| **4** | **30** | **1** | 0,052 | 0,048 | 0,048 |
| **0.5** | **30** | **1.5** | 0,082\* | 0,048 | 0,048 |
| **1** | **30** | **1.5** | 0,050 | 0,049 | 0,048 |
| **2** | **30** | **1.5** | 0,027 | 0,049 | 0,048 |
| **4** | **30** | **1.5** | 0,019\* | 0,049 | 0,049 |
| **0.5** | **30** | **2** | 0,109\* | 0,048 | 0,048 |
| **1** | **30** | **2** | 0,049 | 0,049 | 0,048 |
| **2** | **30** | **2** | 0,017\* | 0,050 | 0,049 |
| **4** | **30** | **2** | 0,008\* | 0,049 | 0,049 |
| **0.5** | **40** | **0.5** | 0,017\* | 0,049 | 0,047 |
| **1** | **40** | **0.5** | 0,049 | 0,048 | 0,047 |
| **2** | **40** | **0.5** | 0,109\* | 0,048 | 0,046 |
| **4** | **40** | **0.5** | 0,155\* | 0,047 | 0,047 |
| **0.5** | **40** | **1** | 0,050 | 0,049 | 0,048 |
| **1** | **40** | **1** | 0,049 | 0,049 | 0,048 |
| **2** | **40** | **1** | 0,050 | 0,049 | 0,049 |
| **4** | **40** | **1** | 0,052 | 0,049 | 0,049 |
| **0.5** | **40** | **1.5** | 0,083\* | 0,049 | 0,049 |
| **1** | **40** | **1.5** | 0,050 | 0,050 | 0,049 |
| **2** | **40** | **1.5** | 0,028 | 0,050 | 0,049 |
| **4** | **40** | **1.5** | 0,020\* | 0,049 | 0,049 |
| **0.5** | **40** | **2** | 0,109\* | 0,048 | 0,048 |
| **1** | **40** | **2** | 0,049 | 0,049 | 0,049 |
| **2** | **40** | **2** | 0,017\* | 0,049 | 0,049 |
| **4** | **40** | **2** | 0,008\* | 0,050 | 0,050 |
| **0.5** | **50** | **0.5** | 0,017\* | 0,049 | 0,049 |
| **1** | **50** | **0.5** | 0,050 | 0,049 | 0,049 |
| **2** | **50** | **0.5** | 0,109\* | 0,048 | 0,048 |
| **4** | **50** | **0.5** | 0,154\* | 0,047 | 0,047 |
| **0.5** | **50** | **1** | 0,050 | 0,049 | 0,049 |
| **1** | **50** | **1** | 0,050 | 0,049 | 0,049 |
| **2** | **50** | **1** | 0,050 | 0,049 | 0,049 |
| **4** | **50** | **1** | 0,051 | 0,049 | 0,049 |
| **0.5** | **50** | **1.5** | 0,082\* | 0,049 | 0,049 |
| **1** | **50** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **50** | **1.5** | 0,027 | 0,049 | 0,049 |
| **4** | **50** | **1.5** | 0,019\* | 0,049 | 0,049 |
| **0.5** | **50** | **2** | 0,110\* | 0,049 | 0,049 |
| **1** | **50** | **2** | 0,050 | 0,049 | 0,049 |
| **2** | **50** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **50** | **2** | 0,008\* | 0,049 | 0,049 |
| **0.5** | **100** | **0.5** | 0,017\* | 0,049 | 0,049 |
| **1** | **100** | **0.5** | 0,050 | 0,049 | 0,049 |
| **2** | **100** | **0.5** | 0,109\* | 0,049 | 0,049 |
| **4** | **100** | **0.5** | 0,151\* | 0,049 | 0,049 |
| **0.5** | **100** | **1** | 0,050 | 0,050 | 0,050 |
| **1** | **100** | **1** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **1** | 0,050 | 0,050 | 0,050 |
| **4** | **100** | **1** | 0,050 | 0,049 | 0,049 |
| **0.5** | **100** | **1.5** | 0,082\* | 0,050 | 0,050 |
| **1** | **100** | **1.5** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **1.5** | 0,027 | 0,049 | 0,049 |
| **4** | **100** | **1.5** | 0,019\* | 0,050 | 0,050 |
| **0.5** | **100** | **2** | 0,109\* | 0,050 | 0,050 |
| **1** | **100** | **2** | 0,050 | 0,050 | 0,050 |
| **2** | **100** | **2** | 0,017\* | 0,050 | 0,050 |
| **4** | **100** | **2** | 0,008\* | 0,049 | 0,049 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A3.8b.  *Real alpha risk, when nominal alpha risk = 5%, three,four or five groups are compared and extracted from double exponential distribution, where standard deviation is .* | | | | | | | | | | | |
|  |  |  | **Number of compared groups** | | | | | | | | |
|  |  |  | **3 groups** | | | **4 groups** | | | **5 groups** | | |
| **SDR** | **n1** | **n-ratio** | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test | *F*-test | *W*-test | F\*-test |
| **0.5** | **20** | **0.5** | 0,032 | 0,044 | 0,053 | 0,036 | 0,043 | 0,054 | 0,038 | 0,042 | 0,053 |
| **1** | **20** | **0.5** | 0,048 | 0,043 | 0,045 | 0,048 | 0,042 | 0,046 | 0,049 | 0,042 | 0,046 |
| **2** | **20** | **0.5** | 0,116\* | 0,043 | 0,051 | 0,118\* | 0,043 | 0,056 | 0,117\* | 0,042 | 0,058 |
| **4** | **20** | **0.5** | 0,197\* | 0,043 | 0,060 | 0,215\* | 0,043 | 0,071 | 0,226\* | 0,042 | 0,079\* |
| **0.5** | **20** | **1** | 0,053 | 0,045 | 0,051 | 0,054 | 0,044 | 0,052 | 0,054 | 0,043 | 0,052 |
| **1** | **20** | **1** | 0,048 | 0,045 | 0,047 | 0,049 | 0,044 | 0,047 | 0,048 | 0,043 | 0,047 |
| **2** | **20** | **1** | 0,059 | 0,045 | 0,055 | 0,064 | 0,044 | 0,059 | 0,066 | 0,044 | 0,062 |
| **4** | **20** | **1** | 0,077\* | 0,045 | 0,067 | 0,093\* | 0,044 | 0,080\* | 0,105\* | 0,043 | 0,090\* |
| **0.5** | **20** | **1.5** | 0,076\* | 0,045 | 0,049 | 0,073 | 0,044 | 0,050 | 0,071 | 0,043 | 0,051 |
| **1** | **20** | **1.5** | 0,048 | 0,046 | 0,047 | 0,048 | 0,044 | 0,047 | 0,048 | 0,043 | 0,047 |
| **2** | **20** | **1.5** | 0,033 | 0,046 | 0,055 | 0,037 | 0,045 | 0,060 | 0,040 | 0,044 | 0,062 |
| **4** | **20** | **1.5** | 0,034 | 0,046 | 0,069 | 0,044 | 0,045 | 0,082\* | 0,051 | 0,044 | 0,092\* |
| **0.5** | **20** | **2** | 0,100\* | 0,045 | 0,048 | 0,094\* | 0,044 | 0,049 | 0,089\* | 0,043 | 0,050 |
| **1** | **20** | **2** | 0,049 | 0,046 | 0,047 | 0,049 | 0,044 | 0,047 | 0,049 | 0,044 | 0,047 |
| **2** | **20** | **2** | 0,020\* | 0,046 | 0,055 | 0,023\* | 0,045 | 0,059 | 0,025 | 0,044 | 0,062 |
| **4** | **20** | **2** | 0,015\* | 0,046 | 0,069 | 0,021\* | 0,045 | 0,083\* | 0,026 | 0,044 | 0,092\* |
| **0.5** | **30** | **0.5** | 0,032 | 0,046 | 0,055 | 0,037 | 0,045 | 0,056 | 0,039 | 0,045 | 0,055 |
| **1** | **30** | **0.5** | 0,049 | 0,046 | 0,047 | 0,049 | 0,045 | 0,047 | 0,048 | 0,044 | 0,047 |
| **2** | **30** | **0.5** | 0,117\* | 0,045 | 0,055 | 0,119\* | 0,045 | 0,059 | 0,119\* | 0,045 | 0,062 |
| **4** | **30** | **0.5** | 0,194\* | 0,045 | 0,065 | 0,212\* | 0,045 | 0,078\* | 0,223\* | 0,044 | 0,086\* |
| **0.5** | **30** | **1** | 0,054 | 0,047 | 0,052 | 0,055 | 0,046 | 0,053 | 0,055 | 0,046 | 0,053 |
| **1** | **30** | **1** | 0,049 | 0,047 | 0,048 | 0,049 | 0,046 | 0,048 | 0,049 | 0,046 | 0,048 |
| **2** | **30** | **1** | 0,059 | 0,047 | 0,057 | 0,064 | 0,046 | 0,061 | 0,067 | 0,045 | 0,064 |
| **4** | **30** | **1** | 0,077\* | 0,047 | 0,070 | 0,093\* | 0,046 | 0,084\* | 0,105\* | 0,046 | 0,094\* |
| **0.5** | **30** | **1.5** | 0,077\* | 0,047 | 0,051 | 0,074 | 0,046 | 0,052 | 0,072 | 0,046 | 0,052 |
| **1** | **30** | **1.5** | 0,049 | 0,047 | 0,048 | 0,049 | 0,047 | 0,049 | 0,049 | 0,046 | 0,049 |
| **2** | **30** | **1.5** | 0,033 | 0,048 | 0,057 | 0,037 | 0,046 | 0,061 | 0,040 | 0,046 | 0,064 |
| **4** | **30** | **1.5** | 0,034 | 0,048 | 0,071 | 0,044 | 0,046 | 0,085\* | 0,052 | 0,046 | 0,095\* |
| **0.5** | **30** | **2** | 0,100\* | 0,046 | 0,050 | 0,095\* | 0,046 | 0,051 | 0,090\* | 0,045 | 0,051 |
| **1** | **30** | **2** | 0,049 | 0,047 | 0,048 | 0,049 | 0,046 | 0,048 | 0,049 | 0,046 | 0,048 |
| **2** | **30** | **2** | 0,020\* | 0,048 | 0,056 | 0,022\* | 0,047 | 0,059 | 0,025 | 0,046 | 0,063 |
| **4** | **30** | **2** | 0,016\* | 0,048 | 0,071 | 0,022\* | 0,047 | 0,084\* | 0,027 | 0,046 | 0,094\* |
| **0.5** | **40** | **0.5** | 0,033 | 0,047 | 0,055 | 0,037 | 0,047 | 0,056 | 0,039 | 0,046 | 0,056 |
| **1** | **40** | **0.5** | 0,049 | 0,047 | 0,048 | 0,049 | 0,046 | 0,048 | 0,049 | 0,046 | 0,049 |
| **2** | **40** | **0.5** | 0,117\* | 0,047 | 0,056 | 0,120\* | 0,046 | 0,062 | 0,119\* | 0,046 | 0,064 |
| **4** | **40** | **0.5** | 0,192\* | 0,046 | 0,068 | 0,210\* | 0,046 | 0,081\* | 0,221\* | 0,046 | 0,090\* |
| **0.5** | **40** | **1** | 0,054 | 0,048 | 0,053 | 0,055 | 0,047 | 0,054 | 0,055 | 0,047 | 0,054 |
| **1** | **40** | **1** | 0,049 | 0,048 | 0,049 | 0,049 | 0,047 | 0,049 | 0,049 | 0,047 | 0,049 |
| **2** | **40** | **1** | 0,059 | 0,048 | 0,058 | 0,064 | 0,047 | 0,062 | 0,068 | 0,047 | 0,066 |
| **4** | **40** | **1** | 0,076\* | 0,047 | 0,071 | 0,092\* | 0,047 | 0,086\* | 0,103\* | 0,046 | 0,095\* |
| **0.5** | **40** | **1.5** | 0,077\* | 0,048 | 0,051 | 0,075 | 0,047 | 0,053 | 0,072 | 0,047 | 0,053 |
| **1** | **40** | **1.5** | 0,049 | 0,048 | 0,049 | 0,049 | 0,047 | 0,049 | 0,049 | 0,047 | 0,049 |
| **2** | **40** | **1.5** | 0,033 | 0,048 | 0,057 | 0,037 | 0,047 | 0,062 | 0,040 | 0,047 | 0,064 |
| **4** | **40** | **1.5** | 0,033 | 0,048 | 0,071 | 0,044 | 0,047 | 0,086\* | 0,052 | 0,047 | 0,096\* |
| **0.5** | **40** | **2** | 0,101\* | 0,047 | 0,050 | 0,095\* | 0,047 | 0,052 | 0,090\* | 0,046 | 0,052 |
| **1** | **40** | **2** | 0,049 | 0,048 | 0,049 | 0,050 | 0,047 | 0,049 | 0,050 | 0,047 | 0,049 |
| **2** | **40** | **2** | 0,020\* | 0,048 | 0,056 | 0,023\* | 0,047 | 0,060 | 0,025 | 0,047 | 0,064 |
| **4** | **40** | **2** | 0,016\* | 0,048 | 0,071 | 0,022\* | 0,047 | 0,086\* | 0,027 | 0,047 | 0,096\* |
| **0.5** | **50** | **0.5** | 0,033 | 0,048 | 0,056 | 0,037 | 0,047 | 0,056 | 0,040 | 0,047 | 0,056 |
| **1** | **50** | **0.5** | 0,050 | 0,048 | 0,049 | 0,049 | 0,047 | 0,048 | 0,049 | 0,046 | 0,048 |
| **2** | **50** | **0.5** | 0,118\* | 0,047 | 0,058 | 0,120\* | 0,047 | 0,063 | 0,120\* | 0,046 | 0,066 |
| **4** | **50** | **0.5** | 0,191\* | 0,047 | 0,070 | 0,209\* | 0,047 | 0,084\* | 0,220\* | 0,047 | 0,094\* |
| **0.5** | **50** | **1** | 0,054 | 0,048 | 0,053 | 0,055 | 0,048 | 0,054 | 0,055 | 0,047 | 0,054 |
| **1** | **50** | **1** | 0,049 | 0,048 | 0,049 | 0,049 | 0,047 | 0,049 | 0,050 | 0,047 | 0,049 |
| **2** | **50** | **1** | 0,059 | 0,048 | 0,058 | 0,065 | 0,048 | 0,063 | 0,067 | 0,047 | 0,066 |
| **4** | **50** | **1** | 0,077\* | 0,048 | 0,073 | 0,092\* | 0,048 | 0,086\* | 0,104\* | 0,047 | 0,097\* |
| **0.5** | **50** | **1.5** | 0,077\* | 0,048 | 0,052 | 0,075 | 0,048 | 0,053 | 0,072 | 0,047 | 0,053 |
| **1** | **50** | **1.5** | 0,049 | 0,048 | 0,048 | 0,050 | 0,048 | 0,049 | 0,049 | 0,048 | 0,049 |
| **2** | **50** | **1.5** | 0,033 | 0,049 | 0,057 | 0,037 | 0,048 | 0,062 | 0,040 | 0,048 | 0,065 |
| **4** | **50** | **1.5** | 0,034 | 0,049 | 0,073 | 0,044 | 0,048 | 0,087\* | 0,051 | 0,047 | 0,097\* |
| **0.5** | **50** | **2** | 0,101\* | 0,048 | 0,051 | 0,095\* | 0,048 | 0,052 | 0,091\* | 0,047 | 0,053 |
| **1** | **50** | **2** | 0,049 | 0,048 | 0,049 | 0,049 | 0,048 | 0,049 | 0,049 | 0,047 | 0,049 |
| **2** | **50** | **2** | 0,020\* | 0,048 | 0,056 | 0,023\* | 0,048 | 0,061 | 0,025 | 0,048 | 0,064 |
| **4** | **50** | **2** | 0,015\* | 0,049 | 0,072 | 0,022\* | 0,048 | 0,086\* | 0,027 | 0,047 | 0,097\* |
| **0.5** | **100** | **0.5** | 0,033 | 0,049 | 0,057 | 0,038 | 0,049 | 0,057 | 0,040 | 0,049 | 0,057 |
| **1** | **100** | **0.5** | 0,050 | 0,049 | 0,049 | 0,050 | 0,048 | 0,049 | 0,049 | 0,048 | 0,049 |
| **2** | **100** | **0.5** | 0,119\* | 0,049 | 0,060 | 0,121\* | 0,048 | 0,065 | 0,120\* | 0,048 | 0,068 |
| **4** | **100** | **0.5** | 0,188\* | 0,049 | 0,073 | 0,207\* | 0,048 | 0,088\* | 0,218\* | 0,048 | 0,099\* |
| **0.5** | **100** | **1** | 0,054 | 0,049 | 0,054 | 0,056 | 0,049 | 0,055 | 0,055 | 0,048 | 0,055 |
| **1** | **100** | **1** | 0,050 | 0,049 | 0,050 | 0,050 | 0,049 | 0,050 | 0,049 | 0,048 | 0,049 |
| **2** | **100** | **1** | 0,060 | 0,049 | 0,059 | 0,065 | 0,049 | 0,064 | 0,068 | 0,049 | 0,067 |
| **4** | **100** | **1** | 0,075 | 0,049 | 0,073 | 0,092\* | 0,049 | 0,089\* | 0,103\* | 0,049 | 0,100\* |
| **0.5** | **100** | **1.5** | 0,077\* | 0,049 | 0,052 | 0,074 | 0,048 | 0,053 | 0,072 | 0,048 | 0,054 |
| **1** | **100** | **1.5** | 0,050 | 0,050 | 0,050 | 0,050 | 0,049 | 0,050 | 0,050 | 0,049 | 0,050 |
| **2** | **100** | **1.5** | 0,033 | 0,049 | 0,058 | 0,037 | 0,049 | 0,063 | 0,041 | 0,049 | 0,066 |
| **4** | **100** | **1.5** | 0,033 | 0,050 | 0,073 | 0,044 | 0,049 | 0,089\* | 0,051 | 0,049 | 0,099\* |
| **0.5** | **100** | **2** | 0,101\* | 0,049 | 0,051 | 0,095\* | 0,049 | 0,053 | 0,090\* | 0,049 | 0,053 |
| **1** | **100** | **2** | 0,050 | 0,049 | 0,049 | 0,050 | 0,049 | 0,049 | 0,050 | 0,049 | 0,049 |
| **2** | **100** | **2** | 0,020\* | 0,050 | 0,057 | 0,023\* | 0,049 | 0,062 | 0,025 | 0,049 | 0,064 |
| **4** | **100** | **2** | 0,015\* | 0,049 | 0,072 | 0,022\* | 0,049 | 0,087\* | 0,027 | 0,049 | 0,097\* |

## **Supplemental Material 4: power of the *F*-test, *W*-test and *F\**-test**

Assuming the null hypothesis is false and a Type 1 error rate of 5%, a test can yield either a significant result (*p*-value < 5%; or a “true positive” -TP) or a non-significant result (*p*-value > 5%; or a “false negative”-FN). The power is the relative frequency of effects detected as significant, when the null is false (i.e. when there is real differences between groups):

Power= =

In order to compute the power of the *F*-test and 2 famous alternatives when population variances are unequal (*W*-test and *F\**-test of comparison of means, both available on SPSS), we performed 1,000,000 simulations of k samples (where k is respectively 2 and 3)[[5]](#footnote-5) generated under 560 conditions (yielding 2\*560,000,000 simulations in total).

In each condition, k-1 samples were generated from a population where and sample size was 20,30,40,50 or 100. The standard deviation and the sample size of the last sample is a function of the sample sizes ratio (n-ratio = ; ranging from 0.5 to 2 in steps of 0.5) and the SDR (0.5,1,2 or 4). In all conditions, the mean of k-1 groups was 0 and the mean of the last group was 1. Note that because standard deviations and mean deviations vary from one condition to another, the effect size is not systematically the same in all conditions.

The set of simulations was repeated seven times varying the distributions underlying the data.

* **k normal distributions**: In order to assess the power of all tests when the normality assumption is met, data were generated by means of the function “rnorm” (from the package “stats”; “R: The Normal Distribution,” 2016) . Results are in Table A4.1a and A4.1b.
* **k double exponential distributions**: In order to assess the impact of high kurtosis on the power of all tests, data were generated by means of the function “rdoublex” (from the package “smoothmest”; "R: The double exponential (Laplace) distribution," 2012). Results are in Table A4.2a and A4.2b.
* **k mixed normal distributions**: In order to assess the impact of extremely high kurtosis on the power of all tests, regardless of variance, data were generated by means of the function “rmixnorm” (from the package “bda”; Wang & Wang, 2015). Results are in Table A4.3a and A4.3b.
* **k normal skewed distributions with positive skewness of +0.99**: In order to assess the impact of moderate skewness on the power of all tests, data were generated by means of the function “rsnorm” (from the package “fGarch”; “R: Skew Normal Distribution,” 2017). The normal skewed distribution was chosen because it is the only skewed distribution where the standard deviation ratio can vary without having an impact on skewness. Results are in Table A4.4a and A4.4b.
* **k-1 normal skewed distributions with positive skewness of +0.99** **and 1 normal skewed distribution with negative skewness of -0.99**: In order to assess the impact of unequal shapes, in terms of skewness, on the power of all tests, when data have moderate skewness, data were generated by means of the functions “rsnorm” (from the package “fGarch”; “R: Skew Normal Distribution,” 2017). Results are in Table A4.5a and A4.5b.
* **k-1 chi square distributions with two degrees of freedom, and one normal skewed distribution with positive skewness of +0.99**: In order to assess the impact of high asymetry on the power of all tests, k-1 distributions were generated by means of the functions “rchisq” (“R: The (non-central) Chi-Squared Distribution,” 2016). Because the chi square is non-negative, it is not possible to generate chi-square where = 1, 4 or 8 and µi is the same than the chi-square with two degrees of freedom. However, we wanted to assess the impact of different SDR on type 1 error rate. For these reasons, the kth distribution was generated by means of “rsnorm” in order to follow a normal skewed distribution with positive skewness of +0.99 and mean = 2 (from the package “fGarch”; “R: Skew Normal Distribution,” 2017). Results are in Table A4.6a and A4.6b.
* **k-1 chi square distributions with two degrees of freedom, and one normal skewed distribution with negative skewness of -0.99**: In order to assess the impact of unequal shapes, in terms of skewness, on power of all tests, when distributions have extreme skewness, k-1 distributions were generated by means of the functions “rchisq” (“R: The (non-central) Chi-Squared Distribution,” 2016). The kth distribution was generated by means of “rsnorm” in order to follow a normal skewed distribution with positive skewness of +0.99 and mean = 2 (from the package “fGarch”; “R: Skew Normal Distribution,” 2017). Results are in Table A4.7a and A4.7b.

Finally, because of a common confusion between kurtosis and variance (DeCarlo, 1997, see Supplemental Material 3), and in order to show the impact of kurtosis on power, independently of the variance, a last set of simulations was created and in each condition, k-1 samples were generated from a double exponential distribution where β were 2 (i.e. j2.82) and sample sizes ( were 20,30,40,50 or 100. The scale parameter β and the sample size of the kth group was a function of the sample sizes ratio (n-ratio = ; ranging from 0.5 to 2 in steps of 0.5) and the SDR (respectively 0.5,1,2 or 4). Results are in Table A4.8a and A4.8b.

The observed power was computed by repeating two steps for each condition: in a first step, the *p*-values of the *F*-test, *W*-test and *F*\*-test were extracted for eah dataset, and in a second step, the percent of *p*-values under the nominal alpha risk (5%) was computed for each condition and for each test. We used R commands to generate data from different distributions.

In order to insure the reliability of our calculation method, the observed power, computed when data were extracted from normal distributions (see Table A4.1a and A4.1b), was compared with theoretical power, i.e. the power computed using the power function of the *W*-test, *F*-test and *F\**-test. When assumptions underlying each test are met (i.e. normality for all tests, and equal variances for *F*-test), the computed power is very consistent with theoretical power, one can therefore conclude that the method is reliable.

**Results of the F-test.** When the normality assumption assumptions is met, but the homoscedasticity assumption is not, the power of the *F*-test is not consistent with theoretical expectations. It is particularly true with unequal sample sizes between groups: when there is a positive correlation between sample sizes and standard deviations, power is smaller than expectations, meaning that the power-curve will conduct to overestimate the real power (even when there are 100 subjects per groups). On the other side, when there is a negative correlation between n and sd, power is bigger than expectations, meaning that the power-curve will conduct to underestimate the real power (even when there are 100 subjects per groups). Finally, with equal sample sizes between groups and unequal variances, the power curve with either underestimate the real power (with small sample sizes; i.e ni=20) or overestimate the real power (with big sample sizes; i.e. ni=100).

When the assumption of equal variances is met, one obtains a gain in power especially when distributions have a big kurtosis (See Table A4.3a and A4.3b), or when high skewnesses are combined with skewnesses of opposite signs (See Tables A4.7a and A4.7b). However, the bigger are sample sizes, the closest is the power from the power in normal cases. For examples, with 50 subjets per group, deviations between the observed power and the expected power decreases, whatever distributions the data are extracted from (See Tables A4.3a, A4.3b, A4.7a and A4.7b). Finally, when the assumption of equal variances is not met, the effect of high kurtosis can become bigger than where variances are equal between groups.

## **Results of the W-test**. When the normality assumption is met, but the homoscedasticity assumption is not, contrary to what was observed for *F*-test, the power of the *W*-test is very consistent with theoretical expectations, because the *W*-test is robust against homoscedasticity violations.

However, the *W*-test is in general more affected by abnormality violations than *F*-test, except when homoscedasticity is combined with equal sample sizes and only two groups to compare. In all other situations, there is a bigger gain in power with *W*-test than with *F*-test, particularly when distributions have a high kurtosis (A4.3a and A4.3b), or are highly skewed with unequal skewnesses between groups (see Table A4.7a and A4.7b). Moreover, the gain in power is more important when sample sizes are unequal between groups. However, the bigger are sample sizes, the closest is the power from the power in normal cases.

## **Results of the *F\**-test.** When there are only two groups to compare, the *F\**-test and *W*-test are identical. The power of *F\**-test is therefore very consistent with theoretical expectations, even when variances are unequal between groups. However, when there are more than two groups to compare and unequal variances between groups, power of the *F\**-test is more consistent with theoretical expectations than power of the *F*-test, but less consistent than power of the *W*-test. Whatever the correlation between sample sizes and standard deviations (positive, negative or null), power is bigger than expectations, meaning that the power-curve will conduct to underestimate the real power. This is particularly true with small sample sizes. When sample sizes increase, the gain in power decreases (and one observes a power lower than expectations, even when there are 100 subjects per groups).

Moreover, with heavy tailed distributions, there is a gain in power in comparison with normal distributions. When distribution are skewed, there is either a gain or a loss in power, in comparison with normal distributions, depending on the highness of skewness, and if skewness are of same or opposite signs between groups.

Finally, when the assumption of equal variances is not met, the *F\**-test is more affected by abnomality violations than the *F*- test, but less affected by abnormality violations than the *W*-test. However, as both other tests, the effect of skewed distributions becomes bigger than where variances are equal between groups, and depends on the situation (either a gain or a loss in power).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.1a  *Comparison between observed and expected power, when nominal alpha risk = 5%, two groups are compared and samples are extracted from normal distributions.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,299** | **0,239** | **0,144** | **0,081** | **0,422** | **0,231** | **0,105** | **0,064** | **0,422** | **0,231** | **0,105** | **0,064** |
|  | |  | Obs. | 0,265 | 0,239 | 0,206 | 0,192 | 0,419 | 0,232 | 0,107 | 0,065 | 0,419 | 0,232 | 0,107 | 0,065 |
| **20** | | **1** | **Theo.** | **0,496** | **0,338** | **0,164** | **0,083** | **0,489** | **0,338** | **0,162** | **0,081** | **0,489** | **0,338** | **0,162** | **0,081** |
|  | |  | Obs. | 0,498 | 0,338 | 0,168 | 0,089 | 0,489 | 0,337 | 0,162 | 0,082 | 0,489 | 0,337 | 0,162 | 0,082 |
| **20** | | **1.5** | **Theo.** | **0,631** | **0,397** | **0,173** | **0,083** | **0,513** | **0,394** | **0,208** | **0,098** | **0,513** | **0,394** | **0,208** | **0,098** |
|  | |  | Obs. | 0,618 | 0,397 | 0,146 | 0,050 | 0,513 | 0,394 | 0,207 | 0,097 | 0,513 | 0,394 | 0,207 | 0,097 |
| **20** | | **2** | **Theo.** | **0,722** | **0,435** | **0,179** | **0,084** | **0,525** | **0,429** | **0,246** | **0,113** | **0,525** | **0,429** | **0,246** | **0,113** |
|  | |  | Obs. | 0,686 | 0,435 | 0,131 | 0,031 | 0,525 | 0,428 | 0,245 | 0,113 | 0,525 | 0,428 | 0,245 | 0,113 |
| **30** | | **0.5** | **Theo.** | **0,428** | **0,340** | **0,196** | **0,098** | **0,589** | **0,333** | **0,139** | **0,073** | **0,589** | **0,333** | **0,139** | **0,073** |
|  | |  | Obs. | 0,414 | 0,339 | 0,250 | 0,201 | 0,588 | 0,332 | 0,140 | 0,073 | 0,588 | 0,332 | 0,140 | 0,073 |
| **30** | | **1** | **Theo.** | **0,673** | **0,478** | **0,226** | **0,100** | **0,668** | **0,478** | **0,224** | **0,099** | **0,668** | **0,478** | **0,224** | **0,099** |
|  | |  | Obs. | 0,673 | 0,478 | 0,227 | 0,105 | 0,667 | 0,478 | 0,223 | 0,099 | 0,667 | 0,478 | 0,223 | 0,099 |
| **30** | | **1.5** | **Theo.** | **0,807** | **0,553** | **0,239** | **0,101** | **0,696** | **0,551** | **0,292** | **0,123** | **0,696** | **0,551** | **0,292** | **0,123** |
|  | |  | Obs. | 0,778 | 0,553 | 0,214 | 0,064 | 0,695 | 0,551 | 0,291 | 0,124 | 0,695 | 0,551 | 0,291 | 0,124 |
| **30** | | **2** | **Theo.** | **0,880** | **0,599** | **0,247** | **0,102** | **0,710** | **0,594** | **0,346** | **0,147** | **0,710** | **0,594** | **0,346** | **0,147** |
|  | |  | Obs. | 0,832 | 0,600 | 0,203 | 0,043 | 0,710 | 0,594 | 0,347 | 0,147 | 0,710 | 0,594 | 0,347 | 0,147 |
| **40** | | **0.5** | **Theo.** | **0,543** | **0,435** | **0,247** | **0,114** | **0,719** | **0,429** | **0,173** | **0,082** | **0,719** | **0,429** | **0,173** | **0,082** |
|  | |  | Obs. | 0,553 | 0,435 | 0,294 | 0,214 | 0,718 | 0,429 | 0,173 | 0,082 | 0,718 | 0,429 | 0,173 | 0,082 |
| **40** | | **1** | **Theo.** | **0,798** | **0,598** | **0,287** | **0,118** | **0,794** | **0,598** | **0,285** | **0,117** | **0,794** | **0,598** | **0,285** | **0,117** |
|  | |  | Obs. | 0,797 | 0,599 | 0,288 | 0,121 | 0,794 | 0,598 | 0,285 | 0,116 | 0,794 | 0,598 | 0,285 | 0,116 |
| **40** | | **1.5** | **Theo.** | **0,906** | **0,679** | **0,305** | **0,119** | **0,819** | **0,678** | **0,372** | **0,150** | **0,819** | **0,678** | **0,372** | **0,150** |
|  | |  | Obs. | 0,879 | 0,679 | 0,284 | 0,080 | 0,820 | 0,677 | 0,373 | 0,149 | 0,820 | 0,677 | 0,373 | 0,149 |
| **40** | | **2** | **Theo.** | **0,952** | **0,726** | **0,315** | **0,120** | **0,832** | **0,722** | **0,441** | **0,181** | **0,832** | **0,722** | **0,441** | **0,181** |
|  | |  | Obs. | 0,914 | 0,726 | 0,278 | 0,056 | 0,833 | 0,722 | 0,440 | 0,181 | 0,833 | 0,722 | 0,440 | 0,181 |
| **50** | | **0.5** | **Theo.** | **0,641** | **0,522** | **0,298** | **0,131** | **0,813** | **0,516** | **0,207** | **0,091** | **0,813** | **0,516** | **0,207** | **0,091** |
|  | |  | Obs. | 0,670 | 0,522 | 0,337 | 0,226 | 0,813 | 0,516 | 0,208 | 0,091 | 0,813 | 0,516 | 0,208 | 0,091 |
| **50** | | **1** | **Theo.** | **0,879** | **0,697** | **0,347** | **0,136** | **0,877** | **0,697** | **0,345** | **0,134** | **0,877** | **0,697** | **0,345** | **0,134** |
|  | |  | Obs. | 0,879 | 0,697 | 0,348 | 0,139 | 0,877 | 0,697 | 0,345 | 0,135 | 0,877 | 0,697 | 0,345 | 0,135 |
| **50** | | **1.5** | **Theo.** | **0,956** | **0,776** | **0,368** | **0,138** | **0,897** | **0,774** | **0,449** | **0,176** | **0,897** | **0,774** | **0,449** | **0,176** |
|  | |  | Obs. | 0,935 | 0,776 | 0,353 | 0,097 | 0,897 | 0,775 | 0,449 | 0,176 | 0,897 | 0,775 | 0,449 | 0,176 |
| **50** | | **2** | **Theo.** | **0,982** | **0,818** | **0,380** | **0,139** | **0,907** | **0,816** | **0,527** | **0,215** | **0,907** | **0,816** | **0,527** | **0,215** |
|  | |  | Obs. | 0,957 | 0,818 | 0,356 | 0,071 | 0,906 | 0,815 | 0,527 | 0,215 | 0,906 | 0,815 | 0,527 | 0,215 |
| **100** | | **0.5** | **Theo.** | **0,911** | **0,818** | **0,529** | **0,217** | **0,982** | **0,816** | **0,375** | **0,137** | **0,982** | **0,816** | **0,375** | **0,137** |
|  | |  | Obs. | 0,950 | 0,818 | 0,525 | 0,294 | 0,982 | 0,815 | 0,375 | 0,137 | 0,982 | 0,815 | 0,375 | 0,137 |
| **100** | | **1** | **Theo.** | **0,994** | **0,940** | **0,605** | **0,226** | **0,993** | **0,940** | **0,603** | **0,225** | **0,993** | **0,940** | **0,603** | **0,225** |
|  | |  | Obs. | 0,994 | 0,941 | 0,604 | 0,228 | 0,994 | 0,941 | 0,603 | 0,225 | 0,994 | 0,941 | 0,603 | 0,225 |
| **100** | | **1.5** | **Theo.** | **0,999** | **0,971** | **0,635** | **0,230** | **0,996** | **0,971** | **0,739** | **0,307** | **0,996** | **0,971** | **0,739** | **0,307** |
|  | |  | Obs. | 0,998 | 0,971 | 0,651 | 0,188 | 0,996 | 0,971 | 0,739 | 0,307 | 0,996 | 0,971 | 0,739 | 0,307 |
| **100** | | **2** | **Theo.** | **1,000** | **0,983** | **0,651** | **0,232** | **0,997** | **0,982** | **0,821** | **0,382** | **0,997** | **0,982** | **0,821** | **0,382** |
|  | |  | Obs. | 0,999 | 0,982 | 0,683 | 0,162 | 0,997 | 0,982 | 0,820 | 0,382 | 0,997 | 0,982 | 0,820 | 0,382 |

# 

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.1b  *Comparison between observed and expected power, when nominal alpha risk = 5%, three groups are compared and samples are extracted from normal distributions.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,244** | **0,214** | **0,150** | **0,088** | **0,463** | **0,204** | **0,090** | **0,060** | **0,291** | **0,211** | **0,112** | **0,067** |
|  | |  | Obs. | 0,192 | 0,214 | 0,220 | 0,232 | 0,463 | 0,209 | 0,095 | 0,062 | 0,282 | 0,209 | 0,124 | 0,086 |
| **20** | | **1** | **Theo.** | **0,435** | **0,337** | **0,186** | **0,092** | **0,591** | **0,329** | **0,135** | **0,072** | **0,431** | **0,337** | **0,182** | **0,089** |
|  | |  | Obs. | 0,452 | 0,338 | 0,196 | 0,124 | 0,593 | 0,329 | 0,136 | 0,073 | 0,443 | 0,336 | 0,188 | 0,111 |
| **20** | | **1.5** | **Theo.** | **0,589** | **0,424** | **0,205** | **0,094** | **0,644** | **0,414** | **0,176** | **0,083** | **0,512** | **0,423** | **0,244** | **0,111** |
|  | |  | Obs. | 0,627 | 0,424 | 0,181 | 0,076 | 0,647 | 0,413 | 0,176 | 0,083 | 0,532 | 0,421 | 0,245 | 0,132 |
| **20** | | **2** | **Theo.** | **0,703** | **0,487** | **0,217** | **0,095** | **0,672** | **0,473** | **0,214** | **0,094** | **0,565** | **0,483** | **0,297** | **0,132** |
|  | |  | Obs. | 0,732 | 0,487 | 0,169 | 0,050 | 0,677 | 0,472 | 0,213 | 0,093 | 0,586 | 0,481 | 0,292 | 0,151 |
| **30** | | **0.5** | **Theo.** | **0,357** | **0,310** | **0,208** | **0,109** | **0,658** | **0,300** | **0,116** | **0,066** | **0,425** | **0,307** | **0,152** | **0,078** |
|  | |  | Obs. | 0,320 | 0,310 | 0,267 | 0,242 | 0,657 | 0,303 | 0,118 | 0,068 | 0,440 | 0,305 | 0,162 | 0,099 |
| **30** | | **1** | **Theo.** | **0,617** | **0,489** | **0,265** | **0,116** | **0,791** | **0,482** | **0,186** | **0,084** | **0,613** | **0,489** | **0,261** | **0,112** |
|  | |  | Obs. | 0,659 | 0,490 | 0,267 | 0,143 | 0,793 | 0,482 | 0,187 | 0,085 | 0,654 | 0,489 | 0,261 | 0,133 |
| **30** | | **1.5** | **Theo.** | **0,782** | **0,602** | **0,295** | **0,118** | **0,838** | **0,594** | **0,251** | **0,102** | **0,708** | **0,601** | **0,355** | **0,147** |
|  | |  | Obs. | 0,817 | 0,602 | 0,263 | 0,098 | 0,841 | 0,594 | 0,251 | 0,102 | 0,748 | 0,600 | 0,341 | 0,165 |
| **30** | | **2** | **Theo.** | **0,876** | **0,676** | **0,313** | **0,120** | **0,861** | **0,665** | **0,310** | **0,119** | **0,762** | **0,673** | **0,431** | **0,180** |
|  | |  | Obs. | 0,889 | 0,675 | 0,260 | 0,070 | 0,864 | 0,666 | 0,309 | 0,119 | 0,797 | 0,671 | 0,410 | 0,194 |
| **40** | | **0.5** | **Theo.** | **0,464** | **0,404** | **0,268** | **0,131** | **0,796** | **0,394** | **0,142** | **0,072** | **0,548** | **0,401** | **0,194** | **0,090** |
|  | |  | Obs. | 0,463 | 0,404 | 0,315 | 0,256 | 0,796 | 0,395 | 0,145 | 0,074 | 0,591 | 0,400 | 0,202 | 0,112 |
| **40** | | **1** | **Theo.** | **0,754** | **0,621** | **0,345** | **0,140** | **0,903** | **0,615** | **0,238** | **0,096** | **0,751** | **0,621** | **0,341** | **0,137** |
|  | |  | Obs. | 0,808 | 0,621 | 0,334 | 0,164 | 0,904 | 0,615 | 0,239 | 0,097 | 0,805 | 0,621 | 0,330 | 0,156 |
| **40** | | **1.5** | **Theo.** | **0,893** | **0,739** | **0,384** | **0,144** | **0,934** | **0,733** | **0,327** | **0,121** | **0,837** | **0,738** | **0,461** | **0,184** |
|  | |  | Obs. | 0,919 | 0,740 | 0,346 | 0,119 | 0,935 | 0,734 | 0,326 | 0,121 | 0,878 | 0,739 | 0,432 | 0,198 |
| **40** | | **2** | **Theo.** | **0,954** | **0,808** | **0,407** | **0,146** | **0,947** | **0,800** | **0,405** | **0,146** | **0,881** | **0,805** | **0,553** | **0,230** |
|  | |  | Obs. | 0,958 | 0,808 | 0,353 | 0,091 | 0,949 | 0,802 | 0,404 | 0,145 | 0,912 | 0,805 | 0,516 | 0,236 |
| **50** | | **0.5** | **Theo.** | **0,563** | **0,493** | **0,328** | **0,154** | **0,884** | **0,484** | **0,168** | **0,078** | **0,653** | **0,491** | **0,237** | **0,102** |
|  | |  | Obs. | 0,595 | 0,492 | 0,358 | 0,270 | 0,884 | 0,484 | 0,171 | 0,080 | 0,716 | 0,489 | 0,240 | 0,124 |
| **50** | | **1** | **Theo.** | **0,849** | **0,727** | **0,423** | **0,165** | **0,958** | **0,722** | **0,292** | **0,109** | **0,847** | **0,727** | **0,419** | **0,162** |
|  | |  | Obs. | 0,900 | 0,727 | 0,400 | 0,186 | 0,959 | 0,722 | 0,293 | 0,110 | 0,899 | 0,726 | 0,396 | 0,179 |
| **50** | | **1.5** | **Theo.** | **0,951** | **0,836** | **0,469** | **0,170** | **0,975** | **0,832** | **0,401** | **0,141** | **0,914** | **0,835** | **0,557** | **0,222** |
|  | |  | Obs. | 0,967 | 0,836 | 0,426 | 0,142 | 0,976 | 0,832 | 0,401 | 0,141 | 0,946 | 0,835 | 0,517 | 0,229 |
| **50** | | **2** | **Theo.** | **0,984** | **0,891** | **0,496** | **0,173** | **0,982** | **0,887** | **0,494** | **0,173** | **0,944** | **0,890** | **0,658** | **0,281** |
|  | |  | Obs. | 0,986 | 0,891 | 0,443 | 0,112 | 0,982 | 0,888 | 0,493 | 0,171 | 0,965 | 0,890 | 0,608 | 0,276 |
| **100** | | **0.5** | **Theo.** | **0,872** | **0,810** | **0,599** | **0,272** | **0,996** | **0,806** | **0,308** | **0,111** | **0,930** | **0,809** | **0,451** | **0,165** |
|  | |  | Obs. | 0,948 | 0,810 | 0,550 | 0,341 | 0,996 | 0,804 | 0,310 | 0,111 | 0,975 | 0,809 | 0,421 | 0,182 |
| **100** | | **1** | **Theo.** | **0,992** | **0,962** | **0,732** | **0,298** | **1,000** | **0,961** | **0,542** | **0,177** | **0,991** | **0,962** | **0,729** | **0,294** |
|  | |  | Obs. | 0,998 | 0,962 | 0,900 | 0,291 | 1,000 | 0,961 | 0,600 | 0,178 | 0,998 | 0,962 | 0,900 | 0,287 |
| **100** | | **1.5** | **Theo.** | **0,999** | **0,990** | **0,784** | **0,308** | **1,000** | **0,989** | **0,705** | **0,246** | **0,998** | **0,990** | **0,866** | **0,415** |
|  | |  | Obs. | 1,000 | 0,989 | 0,736 | 0,262 | 1,000 | 0,989 | 0,705 | 0,247 | 1,000 | 0,989 | 0,805 | 0,381 |
| **100** | | **2** | **Theo.** | **1,000** | **0,996** | **0,812** | **0,313** | **1,000** | **0,996** | **0,811** | **0,313** | **0,999** | **0,996** | **0,931** | **0,521** |
|  | |  | Obs. | 1,000 | 0,996 | 0,783 | 0,238 | 1,000 | 0,996 | 0,811 | 0,312 | 1,000 | 0,996 | 0,884 | 0,464 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.2a  *Comparison between observed and expected power, when nominal alpha risk = 5%, two groups are compared and samples are extracted from double exponential distributions.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,265** | **0,239** | **0,206** | **0,192** | **0,419** | **0,232** | **0,107** | **0,065** | **0,419** | **0,232** | **0,107** | **0,065** |
|  | |  | Obs. | 0,298 | 0,258 | 0,216 | 0,196 | 0,445 | 0,257 | 0,118 | 0,064 | 0,445 | 0,257 | 0,118 | 0,064 |
| **20** | | **1** | **Theo.** | **0,498** | **0,338** | **0,168** | **0,089** | **0,489** | **0,337** | **0,162** | **0,082** | **0,489** | **0,337** | **0,162** | **0,082** |
|  | |  | Obs. | 0,524 | 0,358 | 0,180 | 0,092 | 0,515 | 0,356 | 0,175 | 0,084 | 0,515 | 0,356 | 0,175 | 0,084 |
| **20** | | **1.5** | **Theo.** | **0,618** | **0,397** | **0,146** | **0,050** | **0,513** | **0,394** | **0,207** | **0,097** | **0,513** | **0,394** | **0,207** | **0,097** |
|  | |  | Obs. | 0,635 | 0,414 | 0,158 | 0,052 | 0,540 | 0,413 | 0,219 | 0,102 | 0,540 | 0,413 | 0,219 | 0,102 |
| **20** | | **2** | **Theo.** | **0,686** | **0,435** | **0,131** | **0,031** | **0,525** | **0,428** | **0,245** | **0,113** | **0,525** | **0,428** | **0,245** | **0,113** |
|  | |  | Obs. | 0,698 | 0,449 | 0,142 | 0,033 | 0,555 | 0,449 | 0,256 | 0,118 | 0,555 | 0,449 | 0,256 | 0,118 |
| **30** | | **0.5** | **Theo.** | **0,414** | **0,339** | **0,250** | **0,201** | **0,588** | **0,332** | **0,140** | **0,073** | **0,588** | **0,332** | **0,140** | **0,073** |
|  | |  | Obs. | 0,439 | 0,357 | 0,263 | 0,208 | 0,602 | 0,358 | 0,155 | 0,075 | 0,602 | 0,358 | 0,155 | 0,075 |
| **30** | | **1** | **Theo.** | **0,673** | **0,478** | **0,227** | **0,105** | **0,667** | **0,478** | **0,223** | **0,099** | **0,667** | **0,478** | **0,223** | **0,099** |
|  | |  | Obs. | 0,684 | 0,491 | 0,240 | 0,109 | 0,679 | 0,490 | 0,235 | 0,103 | 0,679 | 0,490 | 0,235 | 0,103 |
| **30** | | **1.5** | **Theo.** | **0,778** | **0,553** | **0,214** | **0,064** | **0,695** | **0,551** | **0,291** | **0,124** | **0,695** | **0,551** | **0,291** | **0,124** |
|  | |  | Obs. | 0,783 | 0,562 | 0,225 | 0,067 | 0,706 | 0,561 | 0,302 | 0,128 | 0,706 | 0,561 | 0,302 | 0,128 |
| **30** | | **2** | **Theo.** | **0,832** | **0,600** | **0,203** | **0,043** | **0,710** | **0,594** | **0,347** | **0,147** | **0,710** | **0,594** | **0,347** | **0,147** |
|  | |  | Obs. | 0,833 | 0,607 | 0,213 | 0,045 | 0,720 | 0,605 | 0,355 | 0,152 | 0,720 | 0,605 | 0,355 | 0,152 |
| **40** | | **0.5** | **Theo.** | **0,553** | **0,435** | **0,294** | **0,214** | **0,718** | **0,429** | **0,173** | **0,082** | **0,718** | **0,429** | **0,173** | **0,082** |
|  | |  | Obs. | 0,568 | 0,450 | 0,307 | 0,221 | 0,724 | 0,449 | 0,191 | 0,085 | 0,724 | 0,449 | 0,191 | 0,085 |
| **40** | | **1** | **Theo.** | **0,797** | **0,599** | **0,288** | **0,121** | **0,794** | **0,598** | **0,285** | **0,116** | **0,794** | **0,598** | **0,285** | **0,116** |
|  | |  | Obs. | 0,799 | 0,607 | 0,302 | 0,127 | 0,795 | 0,606 | 0,298 | 0,122 | 0,795 | 0,606 | 0,298 | 0,122 |
| **40** | | **1.5** | **Theo.** | **0,879** | **0,679** | **0,284** | **0,080** | **0,820** | **0,677** | **0,373** | **0,149** | **0,820** | **0,677** | **0,373** | **0,149** |
|  | |  | Obs. | 0,876 | 0,684 | 0,294 | 0,084 | 0,820 | 0,683 | 0,381 | 0,155 | 0,820 | 0,683 | 0,381 | 0,155 |
| **40** | | **2** | **Theo.** | **0,914** | **0,726** | **0,278** | **0,056** | **0,833** | **0,722** | **0,440** | **0,181** | **0,833** | **0,722** | **0,440** | **0,181** |
|  | |  | Obs. | 0,911 | 0,729 | 0,288 | 0,058 | 0,832 | 0,726 | 0,447 | 0,185 | 0,832 | 0,726 | 0,447 | 0,185 |
| **50** | | **0.5** | **Theo.** | **0,670** | **0,522** | **0,337** | **0,226** | **0,813** | **0,516** | **0,208** | **0,091** | **0,813** | **0,516** | **0,208** | **0,091** |
|  | |  | Obs. | 0,678 | 0,533 | 0,349 | 0,235 | 0,813 | 0,532 | 0,224 | 0,096 | 0,813 | 0,532 | 0,224 | 0,096 |
| **50** | | **1** | **Theo.** | **0,879** | **0,697** | **0,348** | **0,139** | **0,877** | **0,697** | **0,345** | **0,135** | **0,877** | **0,697** | **0,345** | **0,135** |
|  | |  | Obs. | 0,876 | 0,702 | 0,360 | 0,143 | 0,874 | 0,702 | 0,357 | 0,139 | 0,874 | 0,702 | 0,357 | 0,139 |
| **50** | | **1.5** | **Theo.** | **0,935** | **0,776** | **0,353** | **0,097** | **0,897** | **0,775** | **0,449** | **0,176** | **0,897** | **0,775** | **0,449** | **0,176** |
|  | |  | Obs. | 0,931 | 0,776 | 0,363 | 0,100 | 0,893 | 0,775 | 0,456 | 0,181 | 0,893 | 0,775 | 0,456 | 0,181 |
| **50** | | **2** | **Theo.** | **0,957** | **0,818** | **0,356** | **0,071** | **0,906** | **0,815** | **0,527** | **0,215** | **0,906** | **0,815** | **0,527** | **0,215** |
|  | |  | Obs. | 0,954 | 0,818 | 0,363 | 0,074 | 0,902 | 0,815 | 0,533 | 0,221 | 0,902 | 0,815 | 0,533 | 0,221 |
| **100** | | **0.5** | **Theo.** | **0,950** | **0,818** | **0,525** | **0,294** | **0,982** | **0,815** | **0,375** | **0,137** | **0,982** | **0,815** | **0,375** | **0,137** |
|  | |  | Obs. | 0,946 | 0,818 | 0,532 | 0,300 | 0,980 | 0,815 | 0,389 | 0,143 | 0,980 | 0,815 | 0,389 | 0,143 |
| **100** | | **1** | **Theo.** | **0,994** | **0,941** | **0,604** | **0,228** | **0,994** | **0,941** | **0,603** | **0,225** | **0,994** | **0,941** | **0,603** | **0,225** |
|  | |  | Obs. | 0,992 | 0,939 | 0,610 | 0,233 | 0,992 | 0,939 | 0,608 | 0,230 | 0,992 | 0,939 | 0,608 | 0,230 |
| **100** | | **1.5** | **Theo.** | **0,998** | **0,971** | **0,651** | **0,188** | **0,996** | **0,971** | **0,739** | **0,307** | **0,996** | **0,971** | **0,739** | **0,307** |
|  | |  | Obs. | 0,997 | 0,970 | 0,654 | 0,194 | 0,995 | 0,969 | 0,740 | 0,312 | 0,995 | 0,969 | 0,740 | 0,312 |
| **100** | | **2** | **Theo.** | **0,999** | **0,982** | **0,683** | **0,162** | **0,997** | **0,982** | **0,820** | **0,382** | **0,997** | **0,982** | **0,820** | **0,382** |
|  | |  | Obs. | 0,999 | 0,981 | 0,683 | 0,165 | 0,995 | 0,981 | 0,820 | 0,386 | 0,995 | 0,981 | 0,820 | 0,386 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.2b  *Comparison between observed and expected power, when nominal alpha risk = 5%, three groups are compared and samples are extracted from double exponential distributions.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,192** | **0,214** | **0,220** | **0,232** | **0,463** | **0,209** | **0,095** | **0,062** | **0,282** | **0,209** | **0,124** | **0,086** |
|  | |  | Obs. | 0,210 | 0,224 | 0,227 | 0,236 | 0,502 | 0,241 | 0,103 | 0,059 | 0,300 | 0,222 | 0,133 | 0,084 |
| **20** | | **1** | **Theo.** | **0,452** | **0,338** | **0,196** | **0,124** | **0,593** | **0,329** | **0,136** | **0,073** | **0,443** | **0,336** | **0,188** | **0,111** |
|  | |  | Obs. | 0,473 | 0,352 | 0,208 | 0,127 | 0,625 | 0,356 | 0,146 | 0,072 | 0,462 | 0,349 | 0,200 | 0,114 |
| **20** | | **1.5** | **Theo.** | **0,627** | **0,424** | **0,181** | **0,076** | **0,647** | **0,413** | **0,176** | **0,083** | **0,532** | **0,421** | **0,245** | **0,132** |
|  | |  | Obs. | 0,642 | 0,439 | 0,193 | 0,080 | 0,680 | 0,439 | 0,187 | 0,084 | 0,550 | 0,434 | 0,255 | 0,137 |
| **20** | | **2** | **Theo.** | **0,732** | **0,487** | **0,169** | **0,050** | **0,677** | **0,472** | **0,213** | **0,093** | **0,586** | **0,481** | **0,292** | **0,151** |
|  | |  | Obs. | 0,741 | 0,499 | 0,180 | 0,053 | 0,710 | 0,498 | 0,224 | 0,096 | 0,602 | 0,493 | 0,301 | 0,157 |
| **30** | | **0.5** | **Theo.** | **0,320** | **0,310** | **0,267** | **0,242** | **0,657** | **0,303** | **0,118** | **0,068** | **0,440** | **0,305** | **0,162** | **0,099** |
|  | |  | Obs. | 0,339 | 0,321 | 0,277 | 0,249 | 0,678 | 0,337 | 0,131 | 0,067 | 0,455 | 0,321 | 0,175 | 0,102 |
| **30** | | **1** | **Theo.** | **0,659** | **0,490** | **0,267** | **0,143** | **0,793** | **0,482** | **0,187** | **0,085** | **0,654** | **0,489** | **0,261** | **0,133** |
|  | |  | Obs. | 0,668 | 0,500 | 0,279 | 0,149 | 0,806 | 0,503 | 0,200 | 0,086 | 0,662 | 0,498 | 0,273 | 0,139 |
| **30** | | **1.5** | **Theo.** | **0,817** | **0,602** | **0,263** | **0,098** | **0,841** | **0,594** | **0,251** | **0,102** | **0,748** | **0,600** | **0,341** | **0,165** |
|  | |  | Obs. | 0,817 | 0,610 | 0,275 | 0,102 | 0,851 | 0,611 | 0,262 | 0,104 | 0,751 | 0,607 | 0,351 | 0,171 |
| **30** | | **2** | **Theo.** | **0,889** | **0,675** | **0,260** | **0,070** | **0,864** | **0,666** | **0,309** | **0,119** | **0,797** | **0,671** | **0,410** | **0,194** |
|  | |  | Obs. | 0,888 | 0,680 | 0,271 | 0,073 | 0,873 | 0,681 | 0,321 | 0,122 | 0,798 | 0,676 | 0,416 | 0,199 |
| **40** | | **0.5** | **Theo.** | **0,463** | **0,404** | **0,315** | **0,256** | **0,796** | **0,395** | **0,145** | **0,074** | **0,591** | **0,400** | **0,202** | **0,112** |
|  | |  | Obs. | 0,476 | 0,414 | 0,323 | 0,263 | 0,804 | 0,426 | 0,158 | 0,075 | 0,600 | 0,415 | 0,215 | 0,116 |
| **40** | | **1** | **Theo.** | **0,808** | **0,621** | **0,334** | **0,164** | **0,904** | **0,615** | **0,239** | **0,097** | **0,805** | **0,621** | **0,330** | **0,156** |
|  | |  | Obs. | 0,807 | 0,627 | 0,345 | 0,170 | 0,907 | 0,628 | 0,252 | 0,099 | 0,804 | 0,626 | 0,341 | 0,162 |
| **40** | | **1.5** | **Theo.** | **0,919** | **0,740** | **0,346** | **0,119** | **0,935** | **0,734** | **0,326** | **0,121** | **0,878** | **0,739** | **0,432** | **0,198** |
|  | |  | Obs. | 0,916 | 0,741 | 0,357 | 0,124 | 0,937 | 0,743 | 0,339 | 0,125 | 0,876 | 0,740 | 0,441 | 0,203 |
| **40** | | **2** | **Theo.** | **0,958** | **0,808** | **0,353** | **0,091** | **0,949** | **0,802** | **0,404** | **0,145** | **0,912** | **0,805** | **0,516** | **0,236** |
|  | |  | Obs. | 0,956 | 0,808 | 0,363 | 0,095 | 0,950 | 0,810 | 0,415 | 0,149 | 0,907 | 0,806 | 0,521 | 0,241 |
| **50** | | **0.5** | **Theo.** | **0,595** | **0,492** | **0,358** | **0,270** | **0,884** | **0,484** | **0,171** | **0,080** | **0,716** | **0,489** | **0,240** | **0,124** |
|  | |  | Obs. | 0,603 | 0,501 | 0,368 | 0,278 | 0,885 | 0,510 | 0,186 | 0,082 | 0,720 | 0,502 | 0,255 | 0,130 |
| **50** | | **1** | **Theo.** | **0,900** | **0,727** | **0,400** | **0,186** | **0,959** | **0,722** | **0,293** | **0,110** | **0,899** | **0,726** | **0,396** | **0,179** |
|  | |  | Obs. | 0,896 | 0,730 | 0,411 | 0,192 | 0,958 | 0,730 | 0,307 | 0,113 | 0,895 | 0,729 | 0,407 | 0,185 |
| **50** | | **1.5** | **Theo.** | **0,967** | **0,836** | **0,426** | **0,142** | **0,976** | **0,832** | **0,401** | **0,141** | **0,946** | **0,835** | **0,517** | **0,229** |
|  | |  | Obs. | 0,964 | 0,835 | 0,435 | 0,148 | 0,975 | 0,836 | 0,412 | 0,145 | 0,942 | 0,834 | 0,523 | 0,235 |
| **50** | | **2** | **Theo.** | **0,986** | **0,891** | **0,443** | **0,112** | **0,982** | **0,888** | **0,493** | **0,171** | **0,965** | **0,890** | **0,608** | **0,276** |
|  | |  | Obs. | 0,984 | 0,890 | 0,451 | 0,117 | 0,982 | 0,891 | 0,502 | 0,177 | 0,961 | 0,888 | 0,611 | 0,282 |
| **100** | | **0.5** | **Theo.** | **0,948** | **0,810** | **0,550** | **0,341** | **0,996** | **0,804** | **0,310** | **0,111** | **0,975** | **0,809** | **0,421** | **0,182** |
|  | |  | Obs. | 0,944 | 0,811 | 0,557 | 0,348 | 0,995 | 0,807 | 0,325 | 0,116 | 0,972 | 0,810 | 0,433 | 0,189 |
| **100** | | **1** | **Theo.** | **0,998** | **0,962** | **0,900** | **0,291** | **1,000** | **0,961** | **0,600** | **0,178** | **0,998** | **0,962** | **0,900** | **0,287** |
|  | |  | Obs. | 0,998 | 0,960 | 0,671 | 0,298 | 1,000 | 0,959 | 0,550 | 0,183 | 0,998 | 0,960 | 0,669 | 0,293 |
| **100** | | **1.5** | **Theo.** | **1,000** | **0,989** | **0,736** | **0,262** | **1,000** | **0,989** | **0,705** | **0,247** | **1,000** | **0,989** | **0,805** | **0,381** |
|  | |  | Obs. | 1,000 | 0,989 | 0,738 | 0,267 | 1,000 | 0,989 | 0,709 | 0,251 | 0,999 | 0,989 | 0,806 | 0,386 |
| **100** | | **2** | **Theo.** | **1,000** | **0,996** | **0,783** | **0,238** | **1,000** | **0,996** | **0,811** | **0,312** | **1,000** | **0,996** | **0,884** | **0,464** |
|  | |  | Obs. | 1,000 | 0,996 | 0,783 | 0,243 | 1,000 | 0,996 | 0,812 | 0,317 | 1,000 | 0,996 | 0,883 | 0,468 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.3a  *Comparison between observed and expected power, when nominal alpha risk = 5%, two groups are compared and samples are extracted from mixed normal distributions.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,265** | **0,239** | **0,206** | **0,192** | **0,419** | **0,232** | **0,107** | **0,065** | **0,419** | **0,232** | **0,107** | **0,065** |
|  | |  | Obs. | 0,357 | 0,298 | 0,231 | 0,195 | 0,496 | 0,299 | 0,130 | 0,064 | 0,496 | 0,299 | 0,130 | 0,064 |
| **20** | | **1** | **Theo.** | **0,498** | **0,338** | **0,168** | **0,089** | **0,489** | **0,337** | **0,162** | **0,082** | **0,489** | **0,337** | **0,162** | **0,082** |
|  | |  | Obs. | 0,572 | 0,399 | 0,204 | 0,097 | 0,563 | 0,395 | 0,197 | 0,089 | 0,563 | 0,395 | 0,197 | 0,089 |
| **20** | | **1.5** | **Theo.** | **0,618** | **0,397** | **0,146** | **0,050** | **0,513** | **0,394** | **0,207** | **0,097** | **0,513** | **0,394** | **0,207** | **0,097** |
|  | |  | Obs. | 0,668 | 0,449 | 0,182 | 0,056 | 0,591 | 0,450 | 0,244 | 0,109 | 0,591 | 0,450 | 0,244 | 0,109 |
| **20** | | **2** | **Theo.** | **0,686** | **0,435** | **0,131** | **0,031** | **0,525** | **0,428** | **0,245** | **0,113** | **0,525** | **0,428** | **0,245** | **0,113** |
|  | |  | Obs. | 0,722 | 0,478 | 0,164 | 0,036 | 0,608 | 0,488 | 0,280 | 0,126 | 0,608 | 0,488 | 0,280 | 0,126 |
| **30** | | **0.5** | **Theo.** | **0,414** | **0,339** | **0,250** | **0,201** | **0,588** | **0,332** | **0,140** | **0,073** | **0,588** | **0,332** | **0,140** | **0,073** |
|  | |  | Obs. | 0,486 | 0,394 | 0,285 | 0,214 | 0,629 | 0,403 | 0,176 | 0,078 | 0,629 | 0,403 | 0,176 | 0,078 |
| **30** | | **1** | **Theo.** | **0,673** | **0,478** | **0,227** | **0,105** | **0,667** | **0,478** | **0,223** | **0,099** | **0,667** | **0,478** | **0,223** | **0,099** |
|  | |  | Obs. | 0,705 | 0,520 | 0,269 | 0,117 | 0,700 | 0,518 | 0,264 | 0,111 | 0,700 | 0,518 | 0,264 | 0,111 |
| **30** | | **1.5** | **Theo.** | **0,778** | **0,553** | **0,214** | **0,064** | **0,695** | **0,551** | **0,291** | **0,124** | **0,695** | **0,551** | **0,291** | **0,124** |
|  | |  | Obs. | 0,791 | 0,584 | 0,250 | 0,074 | 0,726 | 0,586 | 0,324 | 0,139 | 0,726 | 0,586 | 0,324 | 0,139 |
| **30** | | **2** | **Theo.** | **0,832** | **0,600** | **0,203** | **0,043** | **0,710** | **0,594** | **0,347** | **0,147** | **0,710** | **0,594** | **0,347** | **0,147** |
|  | |  | Obs. | 0,836 | 0,623 | 0,236 | 0,050 | 0,739 | 0,628 | 0,375 | 0,163 | 0,739 | 0,628 | 0,375 | 0,163 |
| **40** | | **0.5** | **Theo.** | **0,553** | **0,435** | **0,294** | **0,214** | **0,718** | **0,429** | **0,173** | **0,082** | **0,718** | **0,429** | **0,173** | **0,082** |
|  | |  | Obs. | 0,596 | 0,479 | 0,332 | 0,232 | 0,733 | 0,489 | 0,218 | 0,091 | 0,733 | 0,489 | 0,218 | 0,091 |
| **40** | | **1** | **Theo.** | **0,797** | **0,599** | **0,288** | **0,121** | **0,794** | **0,598** | **0,285** | **0,116** | **0,794** | **0,598** | **0,285** | **0,116** |
|  | |  | Obs. | 0,801 | 0,624 | 0,327 | 0,138 | 0,798 | 0,623 | 0,324 | 0,133 | 0,798 | 0,623 | 0,324 | 0,133 |
| **40** | | **1.5** | **Theo.** | **0,879** | **0,679** | **0,284** | **0,080** | **0,820** | **0,677** | **0,373** | **0,149** | **0,820** | **0,677** | **0,373** | **0,149** |
|  | |  | Obs. | 0,872 | 0,693 | 0,317 | 0,092 | 0,820 | 0,693 | 0,401 | 0,167 | 0,820 | 0,693 | 0,401 | 0,167 |
| **40** | | **2** | **Theo.** | **0,914** | **0,726** | **0,278** | **0,056** | **0,833** | **0,722** | **0,440** | **0,181** | **0,833** | **0,722** | **0,440** | **0,181** |
|  | |  | Obs. | 0,906 | 0,734 | 0,309 | 0,065 | 0,831 | 0,734 | 0,464 | 0,197 | 0,831 | 0,734 | 0,464 | 0,197 |
| **50** | | **0.5** | **Theo.** | **0,670** | **0,522** | **0,337** | **0,226** | **0,813** | **0,516** | **0,208** | **0,091** | **0,813** | **0,516** | **0,208** | **0,091** |
|  | |  | Obs. | 0,692 | 0,554 | 0,374 | 0,247 | 0,813 | 0,561 | 0,256 | 0,102 | 0,813 | 0,561 | 0,256 | 0,102 |
| **50** | | **1** | **Theo.** | **0,879** | **0,697** | **0,348** | **0,139** | **0,877** | **0,697** | **0,345** | **0,135** | **0,877** | **0,697** | **0,345** | **0,135** |
|  | |  | Obs. | 0,871 | 0,709 | 0,383 | 0,156 | 0,869 | 0,708 | 0,379 | 0,152 | 0,869 | 0,708 | 0,379 | 0,152 |
| **50** | | **1.5** | **Theo.** | **0,935** | **0,776** | **0,353** | **0,097** | **0,897** | **0,775** | **0,449** | **0,176** | **0,897** | **0,775** | **0,449** | **0,176** |
|  | |  | Obs. | 0,924 | 0,780 | 0,383 | 0,110 | 0,886 | 0,779 | 0,472 | 0,193 | 0,886 | 0,779 | 0,472 | 0,193 |
| **50** | | **2** | **Theo.** | **0,957** | **0,818** | **0,356** | **0,071** | **0,906** | **0,815** | **0,527** | **0,215** | **0,906** | **0,815** | **0,527** | **0,215** |
|  | |  | Obs. | 0,947 | 0,818 | 0,382 | 0,081 | 0,894 | 0,816 | 0,544 | 0,231 | 0,894 | 0,816 | 0,544 | 0,231 |
| **100** | | **0.5** | **Theo.** | **0,950** | **0,818** | **0,525** | **0,294** | **0,982** | **0,815** | **0,375** | **0,137** | **0,982** | **0,815** | **0,375** | **0,137** |
|  | |  | Obs. | 0,938 | 0,818 | 0,549 | 0,315 | 0,975 | 0,816 | 0,418 | 0,156 | 0,975 | 0,816 | 0,418 | 0,156 |
| **100** | | **1** | **Theo.** | **0,994** | **0,941** | **0,604** | **0,228** | **0,994** | **0,941** | **0,603** | **0,225** | **0,994** | **0,941** | **0,603** | **0,225** |
|  | |  | Obs. | 0,989 | 0,934 | 0,620 | 0,246 | 0,989 | 0,934 | 0,618 | 0,243 | 0,989 | 0,934 | 0,618 | 0,243 |
| **100** | | **1.5** | **Theo.** | **0,998** | **0,971** | **0,651** | **0,188** | **0,996** | **0,971** | **0,739** | **0,307** | **0,996** | **0,971** | **0,739** | **0,307** |
|  | |  | Obs. | 0,996 | 0,966 | 0,659 | 0,204 | 0,992 | 0,965 | 0,742 | 0,321 | 0,992 | 0,965 | 0,742 | 0,321 |
| **100** | | **2** | **Theo.** | **0,999** | **0,982** | **0,683** | **0,162** | **0,997** | **0,982** | **0,820** | **0,382** | **0,997** | **0,982** | **0,820** | **0,382** |
|  | |  | Obs. | 0,998 | 0,979 | 0,688 | 0,174 | 0,993 | 0,977 | 0,820 | 0,393 | 0,993 | 0,977 | 0,820 | 0,393 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.3b  *Comparison between observed and expected power, when nominal alpha risk = 5%, three groups are compared and samples are extracted from mixed normal distributions.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,192** | **0,214** | **0,220** | **0,232** | **0,463** | **0,209** | **0,095** | **0,062** | **0,282** | **0,209** | **0,124** | **0,086** |
|  | |  | Obs. | 0,248 | 0,247 | 0,237 | 0,235 | 0,572 | 0,288 | 0,113 | 0,057 | 0,337 | 0,246 | 0,141 | 0,083 |
| **20** | | **1** | **Theo.** | **0,452** | **0,338** | **0,196** | **0,124** | **0,593** | **0,329** | **0,136** | **0,073** | **0,443** | **0,336** | **0,188** | **0,111** |
|  | |  | Obs. | 0,510 | 0,385 | 0,231 | 0,133 | 0,679 | 0,409 | 0,167 | 0,072 | 0,498 | 0,378 | 0,222 | 0,119 |
| **20** | | **1.5** | **Theo.** | **0,627** | **0,424** | **0,181** | **0,076** | **0,647** | **0,413** | **0,176** | **0,083** | **0,532** | **0,421** | **0,245** | **0,132** |
|  | |  | Obs. | 0,665 | 0,467 | 0,217 | 0,085 | 0,732 | 0,486 | 0,211 | 0,086 | 0,581 | 0,459 | 0,276 | 0,146 |
| **20** | | **2** | **Theo.** | **0,732** | **0,487** | **0,169** | **0,050** | **0,677** | **0,472** | **0,213** | **0,093** | **0,586** | **0,481** | **0,292** | **0,151** |
|  | |  | Obs. | 0,753 | 0,523 | 0,205 | 0,058 | 0,761 | 0,545 | 0,250 | 0,099 | 0,628 | 0,517 | 0,321 | 0,167 |
| **30** | | **0.5** | **Theo.** | **0,320** | **0,310** | **0,267** | **0,242** | **0,657** | **0,303** | **0,118** | **0,068** | **0,440** | **0,305** | **0,162** | **0,099** |
|  | |  | Obs. | 0,375 | 0,344 | 0,293 | 0,256 | 0,720 | 0,395 | 0,148 | 0,067 | 0,486 | 0,351 | 0,194 | 0,103 |
| **30** | | **1** | **Theo.** | **0,659** | **0,490** | **0,267** | **0,143** | **0,793** | **0,482** | **0,187** | **0,085** | **0,654** | **0,489** | **0,261** | **0,133** |
|  | |  | Obs. | 0,683 | 0,522 | 0,304 | 0,159 | 0,828 | 0,546 | 0,227 | 0,089 | 0,676 | 0,519 | 0,297 | 0,148 |
| **30** | | **1.5** | **Theo.** | **0,817** | **0,602** | **0,263** | **0,098** | **0,841** | **0,594** | **0,251** | **0,102** | **0,748** | **0,600** | **0,341** | **0,165** |
|  | |  | Obs. | 0,820 | 0,625 | 0,301 | 0,110 | 0,871 | 0,643 | 0,292 | 0,110 | 0,757 | 0,620 | 0,373 | 0,183 |
| **30** | | **2** | **Theo.** | **0,889** | **0,675** | **0,260** | **0,070** | **0,864** | **0,666** | **0,309** | **0,119** | **0,797** | **0,671** | **0,410** | **0,194** |
|  | |  | Obs. | 0,884 | 0,689 | 0,295 | 0,080 | 0,889 | 0,709 | 0,348 | 0,129 | 0,798 | 0,685 | 0,434 | 0,211 |
| **40** | | **0.5** | **Theo.** | **0,463** | **0,404** | **0,315** | **0,256** | **0,796** | **0,395** | **0,145** | **0,074** | **0,591** | **0,400** | **0,202** | **0,112** |
|  | |  | Obs. | 0,502 | 0,434 | 0,343 | 0,274 | 0,818 | 0,483 | 0,183 | 0,076 | 0,617 | 0,444 | 0,241 | 0,122 |
| **40** | | **1** | **Theo.** | **0,808** | **0,621** | **0,334** | **0,164** | **0,904** | **0,615** | **0,239** | **0,097** | **0,805** | **0,621** | **0,330** | **0,156** |
|  | |  | Obs. | 0,808 | 0,640 | 0,370 | 0,183 | 0,912 | 0,657 | 0,282 | 0,106 | 0,804 | 0,638 | 0,365 | 0,175 |
| **40** | | **1.5** | **Theo.** | **0,919** | **0,740** | **0,346** | **0,119** | **0,935** | **0,734** | **0,326** | **0,121** | **0,878** | **0,739** | **0,432** | **0,198** |
|  | |  | Obs. | 0,909 | 0,746 | 0,378 | 0,135 | 0,940 | 0,760 | 0,364 | 0,133 | 0,869 | 0,743 | 0,456 | 0,216 |
| **40** | | **2** | **Theo.** | **0,958** | **0,808** | **0,353** | **0,091** | **0,949** | **0,802** | **0,404** | **0,145** | **0,912** | **0,805** | **0,516** | **0,236** |
|  | |  | Obs. | 0,950 | 0,808 | 0,384 | 0,103 | 0,952 | 0,823 | 0,438 | 0,158 | 0,899 | 0,805 | 0,533 | 0,253 |
| **50** | | **0.5** | **Theo.** | **0,595** | **0,492** | **0,358** | **0,270** | **0,884** | **0,484** | **0,171** | **0,080** | **0,716** | **0,489** | **0,240** | **0,124** |
|  | |  | Obs. | 0,617 | 0,518 | 0,386 | 0,290 | 0,886 | 0,558 | 0,214 | 0,085 | 0,725 | 0,527 | 0,282 | 0,137 |
| **50** | | **1** | **Theo.** | **0,900** | **0,727** | **0,400** | **0,186** | **0,959** | **0,722** | **0,293** | **0,110** | **0,899** | **0,726** | **0,396** | **0,179** |
|  | |  | Obs. | 0,891 | 0,735 | 0,432 | 0,206 | 0,958 | 0,745 | 0,336 | 0,121 | 0,888 | 0,734 | 0,428 | 0,199 |
| **50** | | **1.5** | **Theo.** | **0,967** | **0,836** | **0,426** | **0,142** | **0,976** | **0,832** | **0,401** | **0,141** | **0,946** | **0,835** | **0,517** | **0,229** |
|  | |  | Obs. | 0,958 | 0,834 | 0,454 | 0,159 | 0,974 | 0,843 | 0,436 | 0,154 | 0,934 | 0,832 | 0,535 | 0,248 |
| **50** | | **2** | **Theo.** | **0,986** | **0,891** | **0,443** | **0,112** | **0,982** | **0,888** | **0,493** | **0,171** | **0,965** | **0,890** | **0,608** | **0,276** |
|  | |  | Obs. | 0,980 | 0,887 | 0,468 | 0,126 | 0,980 | 0,895 | 0,521 | 0,186 | 0,953 | 0,884 | 0,619 | 0,293 |
| **100** | | **0.5** | **Theo.** | **0,948** | **0,810** | **0,550** | **0,341** | **0,996** | **0,804** | **0,310** | **0,111** | **0,975** | **0,809** | **0,421** | **0,182** |
|  | |  | Obs. | 0,938 | 0,813 | 0,569 | 0,361 | 0,993 | 0,811 | 0,357 | 0,125 | 0,968 | 0,811 | 0,457 | 0,203 |
| **100** | | **1** | **Theo.** | **0,998** | **0,962** | **0,900** | **0,291** | **1,000** | **0,961** | **0,600** | **0,178** | **0,998** | **0,962** | **0,900** | **0,287** |
|  | |  | Obs. | 0,997 | 0,957 | 0,677 | 0,310 | 0,999 | 0,956 | 0,566 | 0,193 | 0,997 | 0,957 | 0,676 | 0,306 |
| **100** | | **1.5** | **Theo.** | **1,000** | **0,989** | **0,736** | **0,262** | **1,000** | **0,989** | **0,705** | **0,247** | **1,000** | **0,989** | **0,805** | **0,381** |
|  | |  | Obs. | 1,000 | 0,987 | 0,741 | 0,277 | 1,000 | 0,987 | 0,716 | 0,261 | 0,999 | 0,987 | 0,807 | 0,395 |
| **100** | | **2** | **Theo.** | **1,000** | **0,996** | **0,783** | **0,238** | **1,000** | **0,996** | **0,811** | **0,312** | **1,000** | **0,996** | **0,884** | **0,464** |
|  | |  | Obs. | 1,000 | 0,995 | 0,784 | 0,252 | 1,000 | 0,995 | 0,815 | 0,326 | 1,000 | 0,995 | 0,882 | 0,475 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.4a  *Comparison between observed and expected power, when nominal alpha risk = 5%, two groups are compared and samples are extracted from normal right skewed distributions.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,265** | **0,239** | **0,206** | **0,192** | **0,419** | **0,232** | **0,107** | **0,065** | **0,419** | **0,232** | **0,107** | **0,065** |
|  | |  | Obs. | 0,303 | 0,242 | 0,177 | 0,173 | 0,435 | 0,200 | 0,070 | 0,054 | 0,435 | 0,200 | 0,070 | 0,054 |
| **20** | | **1** | **Theo.** | **0,498** | **0,338** | **0,168** | **0,089** | **0,489** | **0,337** | **0,162** | **0,082** | **0,489** | **0,337** | **0,162** | **0,082** |
|  | |  | Obs. | 0,510 | 0,343 | 0,138 | 0,067 | 0,502 | 0,342 | 0,131 | 0,060 | 0,502 | 0,342 | 0,131 | 0,060 |
| **20** | | **1.5** | **Theo.** | **0,618** | **0,397** | **0,146** | **0,050** | **0,513** | **0,394** | **0,207** | **0,097** | **0,513** | **0,394** | **0,207** | **0,097** |
|  | |  | Obs. | 0,617 | 0,405 | 0,118 | 0,032 | 0,524 | 0,408 | 0,189 | 0,075 | 0,524 | 0,408 | 0,189 | 0,075 |
| **20** | | **2** | **Theo.** | **0,686** | **0,435** | **0,131** | **0,031** | **0,525** | **0,428** | **0,245** | **0,113** | **0,525** | **0,428** | **0,245** | **0,113** |
|  | |  | Obs. | 0,680 | 0,444 | 0,105 | 0,017 | 0,535 | 0,444 | 0,238 | 0,091 | 0,535 | 0,444 | 0,238 | 0,091 |
| **30** | | **0.5** | **Theo.** | **0,414** | **0,339** | **0,250** | **0,201** | **0,588** | **0,332** | **0,140** | **0,073** | **0,588** | **0,332** | **0,140** | **0,073** |
|  | |  | Obs. | 0,432 | 0,340 | 0,223 | 0,180 | 0,591 | 0,313 | 0,098 | 0,055 | 0,591 | 0,313 | 0,098 | 0,055 |
| **30** | | **1** | **Theo.** | **0,673** | **0,478** | **0,227** | **0,105** | **0,667** | **0,478** | **0,223** | **0,099** | **0,667** | **0,478** | **0,223** | **0,099** |
|  | |  | Obs. | 0,664 | 0,481 | 0,202 | 0,080 | 0,658 | 0,481 | 0,196 | 0,075 | 0,658 | 0,481 | 0,196 | 0,075 |
| **30** | | **1.5** | **Theo.** | **0,778** | **0,553** | **0,214** | **0,064** | **0,695** | **0,551** | **0,291** | **0,124** | **0,695** | **0,551** | **0,291** | **0,124** |
|  | |  | Obs. | 0,763 | 0,559 | 0,189 | 0,043 | 0,681 | 0,555 | 0,278 | 0,100 | 0,681 | 0,555 | 0,278 | 0,100 |
| **30** | | **2** | **Theo.** | **0,832** | **0,600** | **0,203** | **0,043** | **0,710** | **0,594** | **0,347** | **0,147** | **0,710** | **0,594** | **0,347** | **0,147** |
|  | |  | Obs. | 0,815 | 0,606 | 0,180 | 0,026 | 0,693 | 0,595 | 0,342 | 0,125 | 0,693 | 0,595 | 0,342 | 0,125 |
| **40** | | **0.5** | **Theo.** | **0,553** | **0,435** | **0,294** | **0,214** | **0,718** | **0,429** | **0,173** | **0,082** | **0,718** | **0,429** | **0,173** | **0,082** |
|  | |  | Obs. | 0,553 | 0,434 | 0,271 | 0,191 | 0,714 | 0,419 | 0,134 | 0,060 | 0,714 | 0,419 | 0,134 | 0,060 |
| **40** | | **1** | **Theo.** | **0,797** | **0,599** | **0,288** | **0,121** | **0,794** | **0,598** | **0,285** | **0,116** | **0,794** | **0,598** | **0,285** | **0,116** |
|  | |  | Obs. | 0,778 | 0,601 | 0,267 | 0,096 | 0,775 | 0,601 | 0,263 | 0,091 | 0,775 | 0,601 | 0,263 | 0,091 |
| **40** | | **1.5** | **Theo.** | **0,879** | **0,679** | **0,284** | **0,080** | **0,820** | **0,677** | **0,373** | **0,149** | **0,820** | **0,677** | **0,373** | **0,149** |
|  | |  | Obs. | 0,860 | 0,682 | 0,264 | 0,058 | 0,797 | 0,674 | 0,363 | 0,127 | 0,797 | 0,674 | 0,363 | 0,127 |
| **40** | | **2** | **Theo.** | **0,914** | **0,726** | **0,278** | **0,056** | **0,833** | **0,722** | **0,440** | **0,181** | **0,833** | **0,722** | **0,440** | **0,181** |
|  | |  | Obs. | 0,897 | 0,729 | 0,261 | 0,037 | 0,806 | 0,714 | 0,438 | 0,161 | 0,806 | 0,714 | 0,438 | 0,161 |
| **50** | | **0.5** | **Theo.** | **0,670** | **0,522** | **0,337** | **0,226** | **0,813** | **0,516** | **0,208** | **0,091** | **0,813** | **0,516** | **0,208** | **0,091** |
|  | |  | Obs. | 0,659 | 0,520 | 0,317 | 0,206 | 0,805 | 0,515 | 0,170 | 0,067 | 0,805 | 0,515 | 0,170 | 0,067 |
| **50** | | **1** | **Theo.** | **0,879** | **0,697** | **0,348** | **0,139** | **0,877** | **0,697** | **0,345** | **0,135** | **0,877** | **0,697** | **0,345** | **0,135** |
|  | |  | Obs. | 0,859 | 0,697 | 0,332 | 0,113 | 0,857 | 0,697 | 0,328 | 0,109 | 0,857 | 0,697 | 0,328 | 0,109 |
| **50** | | **1.5** | **Theo.** | **0,935** | **0,776** | **0,353** | **0,097** | **0,897** | **0,775** | **0,449** | **0,176** | **0,897** | **0,775** | **0,449** | **0,176** |
|  | |  | Obs. | 0,919 | 0,777 | 0,339 | 0,074 | 0,874 | 0,768 | 0,444 | 0,154 | 0,874 | 0,768 | 0,444 | 0,154 |
| **50** | | **2** | **Theo.** | **0,957** | **0,818** | **0,356** | **0,071** | **0,906** | **0,815** | **0,527** | **0,215** | **0,906** | **0,815** | **0,527** | **0,215** |
|  | |  | Obs. | 0,944 | 0,819 | 0,345 | 0,051 | 0,882 | 0,803 | 0,528 | 0,197 | 0,882 | 0,803 | 0,528 | 0,197 |
| **100** | | **0.5** | **Theo.** | **0,950** | **0,818** | **0,525** | **0,294** | **0,982** | **0,815** | **0,375** | **0,137** | **0,982** | **0,815** | **0,375** | **0,137** |
|  | |  | Obs. | 0,936 | 0,818 | 0,519 | 0,274 | 0,978 | 0,830 | 0,354 | 0,110 | 0,978 | 0,830 | 0,354 | 0,110 |
| **100** | | **1** | **Theo.** | **0,994** | **0,941** | **0,604** | **0,228** | **0,994** | **0,941** | **0,603** | **0,225** | **0,994** | **0,941** | **0,603** | **0,225** |
|  | |  | Obs. | 0,989 | 0,940 | 0,608 | 0,206 | 0,989 | 0,940 | 0,607 | 0,203 | 0,989 | 0,940 | 0,607 | 0,203 |
| **100** | | **1.5** | **Theo.** | **0,998** | **0,971** | **0,651** | **0,188** | **0,996** | **0,971** | **0,739** | **0,307** | **0,996** | **0,971** | **0,739** | **0,307** |
|  | |  | Obs. | 0,996 | 0,970 | 0,658 | 0,169 | 0,992 | 0,966 | 0,746 | 0,293 | 0,992 | 0,966 | 0,746 | 0,293 |
| **100** | | **2** | **Theo.** | **0,999** | **0,982** | **0,683** | **0,162** | **0,997** | **0,982** | **0,820** | **0,382** | **0,997** | **0,982** | **0,820** | **0,382** |
|  | |  | Obs. | 0,998 | 0,981 | 0,692 | 0,141 | 0,993 | 0,977 | 0,825 | 0,373 | 0,993 | 0,977 | 0,825 | 0,373 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.4b  *Comparison between observed and expected power, when nominal alpha risk = 5%, three groups are compared and samples are extracted from normal right skewed distributions.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,192** | **0,214** | **0,220** | **0,232** | **0,463** | **0,209** | **0,095** | **0,062** | **0,282** | **0,209** | **0,124** | **0,086** |
|  | |  | Obs. | 0,222 | 0,215 | 0,194 | 0,214 | 0,498 | 0,180 | 0,067 | 0,054 | 0,302 | 0,187 | 0,085 | 0,071 |
| **20** | | **1** | **Theo.** | **0,452** | **0,338** | **0,196** | **0,124** | **0,593** | **0,329** | **0,136** | **0,073** | **0,443** | **0,336** | **0,188** | **0,111** |
|  | |  | Obs. | 0,470 | 0,339 | 0,167 | 0,100 | 0,630 | 0,342 | 0,112 | 0,058 | 0,461 | 0,337 | 0,157 | 0,087 |
| **20** | | **1.5** | **Theo.** | **0,627** | **0,424** | **0,181** | **0,076** | **0,647** | **0,413** | **0,176** | **0,083** | **0,532** | **0,421** | **0,245** | **0,132** |
|  | |  | Obs. | 0,628 | 0,430 | 0,151 | 0,054 | 0,675 | 0,446 | 0,162 | 0,068 | 0,540 | 0,430 | 0,224 | 0,107 |
| **20** | | **2** | **Theo.** | **0,732** | **0,487** | **0,169** | **0,050** | **0,677** | **0,472** | **0,213** | **0,093** | **0,586** | **0,481** | **0,292** | **0,151** |
|  | |  | Obs. | 0,725 | 0,495 | 0,139 | 0,032 | 0,699 | 0,512 | 0,209 | 0,079 | 0,587 | 0,489 | 0,279 | 0,127 |
| **30** | | **0.5** | **Theo.** | **0,320** | **0,310** | **0,267** | **0,242** | **0,657** | **0,303** | **0,118** | **0,068** | **0,440** | **0,305** | **0,162** | **0,099** |
|  | |  | Obs. | 0,343 | 0,308 | 0,243 | 0,222 | 0,687 | 0,282 | 0,087 | 0,055 | 0,451 | 0,289 | 0,122 | 0,078 |
| **30** | | **1** | **Theo.** | **0,659** | **0,490** | **0,267** | **0,143** | **0,793** | **0,482** | **0,187** | **0,085** | **0,654** | **0,489** | **0,261** | **0,133** |
|  | |  | Obs. | 0,655 | 0,491 | 0,242 | 0,118 | 0,804 | 0,501 | 0,164 | 0,067 | 0,649 | 0,490 | 0,235 | 0,108 |
| **30** | | **1.5** | **Theo.** | **0,817** | **0,602** | **0,263** | **0,098** | **0,841** | **0,594** | **0,251** | **0,102** | **0,748** | **0,600** | **0,341** | **0,165** |
|  | |  | Obs. | 0,801 | 0,607 | 0,240 | 0,073 | 0,840 | 0,620 | 0,241 | 0,085 | 0,732 | 0,601 | 0,328 | 0,140 |
| **30** | | **2** | **Theo.** | **0,889** | **0,675** | **0,260** | **0,070** | **0,864** | **0,666** | **0,309** | **0,119** | **0,797** | **0,671** | **0,410** | **0,194** |
|  | |  | Obs. | 0,874 | 0,683 | 0,236 | 0,048 | 0,858 | 0,690 | 0,310 | 0,104 | 0,776 | 0,670 | 0,402 | 0,172 |
| **40** | | **0.5** | **Theo.** | **0,463** | **0,404** | **0,315** | **0,256** | **0,796** | **0,395** | **0,145** | **0,074** | **0,591** | **0,400** | **0,202** | **0,112** |
|  | |  | Obs. | 0,472 | 0,401 | 0,292 | 0,235 | 0,818 | 0,386 | 0,111 | 0,058 | 0,592 | 0,390 | 0,163 | 0,087 |
| **40** | | **1** | **Theo.** | **0,808** | **0,621** | **0,334** | **0,164** | **0,904** | **0,615** | **0,239** | **0,097** | **0,805** | **0,621** | **0,330** | **0,156** |
|  | |  | Obs. | 0,792 | 0,622 | 0,315 | 0,139 | 0,904 | 0,637 | 0,218 | 0,078 | 0,789 | 0,622 | 0,309 | 0,131 |
| **40** | | **1.5** | **Theo.** | **0,919** | **0,740** | **0,346** | **0,119** | **0,935** | **0,734** | **0,326** | **0,121** | **0,878** | **0,739** | **0,432** | **0,198** |
|  | |  | Obs. | 0,903 | 0,743 | 0,329 | 0,095 | 0,928 | 0,754 | 0,321 | 0,104 | 0,857 | 0,735 | 0,426 | 0,175 |
| **40** | | **2** | **Theo.** | **0,958** | **0,808** | **0,353** | **0,091** | **0,949** | **0,802** | **0,404** | **0,145** | **0,912** | **0,805** | **0,516** | **0,236** |
|  | |  | Obs. | 0,947 | 0,812 | 0,337 | 0,068 | 0,940 | 0,815 | 0,409 | 0,130 | 0,891 | 0,798 | 0,513 | 0,216 |
| **50** | | **0.5** | **Theo.** | **0,595** | **0,492** | **0,358** | **0,270** | **0,884** | **0,484** | **0,171** | **0,080** | **0,716** | **0,489** | **0,240** | **0,124** |
|  | |  | Obs. | 0,594 | 0,489 | 0,340 | 0,251 | 0,899 | 0,487 | 0,137 | 0,062 | 0,711 | 0,485 | 0,205 | 0,098 |
| **50** | | **1** | **Theo.** | **0,900** | **0,727** | **0,400** | **0,186** | **0,959** | **0,722** | **0,293** | **0,110** | **0,899** | **0,726** | **0,396** | **0,179** |
|  | |  | Obs. | 0,884 | 0,728 | 0,386 | 0,161 | 0,956 | 0,745 | 0,275 | 0,091 | 0,882 | 0,728 | 0,381 | 0,154 |
| **50** | | **1.5** | **Theo.** | **0,967** | **0,836** | **0,426** | **0,142** | **0,976** | **0,832** | **0,401** | **0,141** | **0,946** | **0,835** | **0,517** | **0,229** |
|  | |  | Obs. | 0,957 | 0,839 | 0,416 | 0,117 | 0,970 | 0,847 | 0,400 | 0,123 | 0,930 | 0,832 | 0,513 | 0,208 |
| **50** | | **2** | **Theo.** | **0,986** | **0,891** | **0,443** | **0,112** | **0,982** | **0,888** | **0,493** | **0,171** | **0,965** | **0,890** | **0,608** | **0,276** |
|  | |  | Obs. | 0,979 | 0,893 | 0,436 | 0,090 | 0,976 | 0,895 | 0,503 | 0,158 | 0,950 | 0,882 | 0,610 | 0,260 |
| **100** | | **0.5** | **Theo.** | **0,948** | **0,810** | **0,550** | **0,341** | **0,996** | **0,804** | **0,310** | **0,111** | **0,975** | **0,809** | **0,421** | **0,182** |
|  | |  | Obs. | 0,937 | 0,810 | 0,546 | 0,325 | 0,997 | 0,834 | 0,285 | 0,090 | 0,971 | 0,819 | 0,405 | 0,156 |
| **100** | | **1** | **Theo.** | **0,998** | **0,962** | **0,900** | **0,291** | **1,000** | **0,961** | **0,600** | **0,178** | **0,998** | **0,962** | **0,900** | **0,287** |
|  | |  | Obs. | 0,997 | 0,963 | 0,674 | 0,274 | 1,000 | 0,970 | 0,547 | 0,158 | 0,997 | 0,963 | 0,672 | 0,269 |
| **100** | | **1.5** | **Theo.** | **1,000** | **0,989** | **0,736** | **0,262** | **1,000** | **0,989** | **0,705** | **0,247** | **1,000** | **0,989** | **0,805** | **0,381** |
|  | |  | Obs. | 1,000 | 0,990 | 0,748 | 0,243 | 1,000 | 0,991 | 0,721 | 0,231 | 0,999 | 0,989 | 0,815 | 0,370 |
| **100** | | **2** | **Theo.** | **1,000** | **0,996** | **0,783** | **0,238** | **1,000** | **0,996** | **0,811** | **0,312** | **1,000** | **0,996** | **0,884** | **0,464** |
|  | |  | Obs. | 1,000 | 0,996 | 0,796 | 0,219 | 1,000 | 0,996 | 0,826 | 0,303 | 1,000 | 0,995 | 0,891 | 0,458 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.5a  *Comparison between observed and expected power, when nominal alpha risk = 5%, two groups are compared, one sample is extracted from normal right skewed distribution, and one sample is extracted from a left skewed distribution.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,265** | **0,239** | **0,206** | **0,192** | **0,419** | **0,232** | **0,107** | **0,065** | **0,419** | **0,232** | **0,107** | **0,065** |
|  | |  | Obs. | 0,311 | 0,278 | 0,246 | 0,224 | 0,443 | 0,280 | 0,161 | 0,106 | 0,443 | 0,280 | 0,161 | 0,106 |
| **20** | | **1** | **Theo.** | **0,498** | **0,338** | **0,168** | **0,089** | **0,489** | **0,337** | **0,162** | **0,082** | **0,489** | **0,337** | **0,162** | **0,082** |
|  | |  | Obs. | 0,509 | 0,367 | 0,207 | 0,123 | 0,501 | 0,366 | 0,202 | 0,116 | 0,501 | 0,366 | 0,202 | 0,116 |
| **20** | | **1.5** | **Theo.** | **0,618** | **0,397** | **0,146** | **0,050** | **0,513** | **0,394** | **0,207** | **0,097** | **0,513** | **0,394** | **0,207** | **0,097** |
|  | |  | Obs. | 0,614 | 0,417 | 0,183 | 0,079 | 0,524 | 0,415 | 0,241 | 0,129 | 0,524 | 0,415 | 0,241 | 0,129 |
| **20** | | **2** | **Theo.** | **0,686** | **0,435** | **0,131** | **0,031** | **0,525** | **0,428** | **0,245** | **0,113** | **0,525** | **0,428** | **0,245** | **0,113** |
|  | |  | Obs. | 0,676 | 0,451 | 0,167 | 0,053 | 0,535 | 0,448 | 0,274 | 0,141 | 0,535 | 0,448 | 0,274 | 0,141 |
| **30** | | **0.5** | **Theo.** | **0,414** | **0,339** | **0,250** | **0,201** | **0,588** | **0,332** | **0,140** | **0,073** | **0,588** | **0,332** | **0,140** | **0,073** |
|  | |  | Obs. | 0,436 | 0,366 | 0,285 | 0,231 | 0,586 | 0,365 | 0,189 | 0,111 | 0,586 | 0,365 | 0,189 | 0,111 |
| **30** | | **1** | **Theo.** | **0,673** | **0,478** | **0,227** | **0,105** | **0,667** | **0,478** | **0,223** | **0,099** | **0,667** | **0,478** | **0,223** | **0,099** |
|  | |  | Obs. | 0,661 | 0,488 | 0,262 | 0,136 | 0,656 | 0,487 | 0,258 | 0,131 | 0,656 | 0,487 | 0,258 | 0,131 |
| **30** | | **1.5** | **Theo.** | **0,778** | **0,553** | **0,214** | **0,064** | **0,695** | **0,551** | **0,291** | **0,124** | **0,695** | **0,551** | **0,291** | **0,124** |
|  | |  | Obs. | 0,759 | 0,554 | 0,245 | 0,091 | 0,680 | 0,552 | 0,316 | 0,151 | 0,680 | 0,552 | 0,316 | 0,151 |
| **30** | | **2** | **Theo.** | **0,832** | **0,600** | **0,203** | **0,043** | **0,710** | **0,594** | **0,347** | **0,147** | **0,710** | **0,594** | **0,347** | **0,147** |
|  | |  | Obs. | 0,811 | 0,598 | 0,232 | 0,065 | 0,691 | 0,592 | 0,365 | 0,172 | 0,691 | 0,592 | 0,365 | 0,172 |
| **40** | | **0.5** | **Theo.** | **0,553** | **0,435** | **0,294** | **0,214** | **0,718** | **0,429** | **0,173** | **0,082** | **0,718** | **0,429** | **0,173** | **0,082** |
|  | |  | Obs. | 0,554 | 0,450 | 0,323 | 0,242 | 0,702 | 0,447 | 0,218 | 0,118 | 0,702 | 0,447 | 0,218 | 0,118 |
| **40** | | **1** | **Theo.** | **0,797** | **0,599** | **0,288** | **0,121** | **0,794** | **0,598** | **0,285** | **0,116** | **0,794** | **0,598** | **0,285** | **0,116** |
|  | |  | Obs. | 0,774 | 0,596 | 0,316 | 0,151 | 0,771 | 0,595 | 0,312 | 0,147 | 0,771 | 0,595 | 0,312 | 0,147 |
| **40** | | **1.5** | **Theo.** | **0,879** | **0,679** | **0,284** | **0,080** | **0,820** | **0,677** | **0,373** | **0,149** | **0,820** | **0,677** | **0,373** | **0,149** |
|  | |  | Obs. | 0,855 | 0,670 | 0,308 | 0,106 | 0,794 | 0,668 | 0,389 | 0,175 | 0,794 | 0,668 | 0,389 | 0,175 |
| **40** | | **2** | **Theo.** | **0,914** | **0,726** | **0,278** | **0,056** | **0,833** | **0,722** | **0,440** | **0,181** | **0,833** | **0,722** | **0,440** | **0,181** |
|  | |  | Obs. | 0,894 | 0,714 | 0,302 | 0,079 | 0,805 | 0,708 | 0,451 | 0,204 | 0,805 | 0,708 | 0,451 | 0,204 |
| **50** | | **0.5** | **Theo.** | **0,670** | **0,522** | **0,337** | **0,226** | **0,813** | **0,516** | **0,208** | **0,091** | **0,813** | **0,516** | **0,208** | **0,091** |
|  | |  | Obs. | 0,657 | 0,528 | 0,361 | 0,253 | 0,790 | 0,523 | 0,248 | 0,126 | 0,790 | 0,523 | 0,248 | 0,126 |
| **50** | | **1** | **Theo.** | **0,879** | **0,697** | **0,348** | **0,139** | **0,877** | **0,697** | **0,345** | **0,135** | **0,877** | **0,697** | **0,345** | **0,135** |
|  | |  | Obs. | 0,854 | 0,685 | 0,368 | 0,167 | 0,852 | 0,685 | 0,365 | 0,163 | 0,852 | 0,685 | 0,365 | 0,163 |
| **50** | | **1.5** | **Theo.** | **0,935** | **0,776** | **0,353** | **0,097** | **0,897** | **0,775** | **0,449** | **0,176** | **0,897** | **0,775** | **0,449** | **0,176** |
|  | |  | Obs. | 0,915 | 0,760 | 0,371 | 0,122 | 0,871 | 0,758 | 0,459 | 0,200 | 0,871 | 0,758 | 0,459 | 0,200 |
| **50** | | **2** | **Theo.** | **0,957** | **0,818** | **0,356** | **0,071** | **0,906** | **0,815** | **0,527** | **0,215** | **0,906** | **0,815** | **0,527** | **0,215** |
|  | |  | Obs. | 0,942 | 0,803 | 0,371 | 0,093 | 0,881 | 0,797 | 0,530 | 0,236 | 0,881 | 0,797 | 0,530 | 0,236 |
| **100** | | **0.5** | **Theo.** | **0,950** | **0,818** | **0,525** | **0,294** | **0,982** | **0,815** | **0,375** | **0,137** | **0,982** | **0,815** | **0,375** | **0,137** |
|  | |  | Obs. | 0,932 | 0,802 | 0,530 | 0,313 | 0,972 | 0,796 | 0,395 | 0,166 | 0,972 | 0,796 | 0,395 | 0,166 |
| **100** | | **1** | **Theo.** | **0,994** | **0,941** | **0,604** | **0,228** | **0,994** | **0,941** | **0,603** | **0,225** | **0,994** | **0,941** | **0,603** | **0,225** |
|  | |  | Obs. | 0,988 | 0,926 | 0,602 | 0,248 | 0,988 | 0,926 | 0,601 | 0,246 | 0,988 | 0,926 | 0,601 | 0,246 |
| **100** | | **1.5** | **Theo.** | **0,998** | **0,971** | **0,651** | **0,188** | **0,996** | **0,971** | **0,739** | **0,307** | **0,996** | **0,971** | **0,739** | **0,307** |
|  | |  | Obs. | 0,996 | 0,962 | 0,645 | 0,211 | 0,992 | 0,961 | 0,729 | 0,324 | 0,992 | 0,961 | 0,729 | 0,324 |
| **100** | | **2** | **Theo.** | **0,999** | **0,982** | **0,683** | **0,162** | **0,997** | **0,982** | **0,820** | **0,382** | **0,997** | **0,982** | **0,820** | **0,382** |
|  | |  | Obs. | 0,998 | 0,976 | 0,674 | 0,182 | 0,993 | 0,974 | 0,808 | 0,392 | 0,993 | 0,974 | 0,808 | 0,392 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.5b  *Comparison between observed and expected power, when nominal alpha risk = 5%, three groups are compared, two samples are extracted from normal right skewed distribution, and one is extracted from a left skewed distribution.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,192** | **0,214** | **0,220** | **0,232** | **0,463** | **0,209** | **0,095** | **0,062** | **0,282** | **0,209** | **0,124** | **0,086** |
|  | |  | Obs. | 0,229 | 0,245 | 0,255 | 0,261 | 0,513 | 0,284 | 0,154 | 0,102 | 0,317 | 0,251 | 0,176 | 0,128 |
| **20** | | **1** | **Theo.** | **0,452** | **0,338** | **0,196** | **0,124** | **0,593** | **0,329** | **0,136** | **0,073** | **0,443** | **0,336** | **0,188** | **0,111** |
|  | |  | Obs. | 0,472 | 0,363 | 0,234 | 0,157 | 0,624 | 0,386 | 0,191 | 0,107 | 0,464 | 0,360 | 0,228 | 0,145 |
| **20** | | **1.5** | **Theo.** | **0,627** | **0,424** | **0,181** | **0,076** | **0,647** | **0,413** | **0,176** | **0,083** | **0,532** | **0,421** | **0,245** | **0,132** |
|  | |  | Obs. | 0,625 | 0,441 | 0,217 | 0,108 | 0,671 | 0,461 | 0,227 | 0,116 | 0,541 | 0,438 | 0,274 | 0,162 |
| **20** | | **2** | **Theo.** | **0,732** | **0,487** | **0,169** | **0,050** | **0,677** | **0,472** | **0,213** | **0,093** | **0,586** | **0,481** | **0,292** | **0,151** |
|  | |  | Obs. | 0,720 | 0,497 | 0,204 | 0,078 | 0,696 | 0,517 | 0,264 | 0,126 | 0,587 | 0,492 | 0,316 | 0,179 |
| **30** | | **0.5** | **Theo.** | **0,320** | **0,310** | **0,267** | **0,242** | **0,657** | **0,303** | **0,118** | **0,068** | **0,440** | **0,305** | **0,162** | **0,099** |
|  | |  | Obs. | 0,350 | 0,335 | 0,297 | 0,268 | 0,669 | 0,361 | 0,174 | 0,104 | 0,459 | 0,337 | 0,208 | 0,137 |
| **30** | | **1** | **Theo.** | **0,659** | **0,490** | **0,267** | **0,143** | **0,793** | **0,482** | **0,187** | **0,085** | **0,654** | **0,489** | **0,261** | **0,133** |
|  | |  | Obs. | 0,652 | 0,500 | 0,295 | 0,174 | 0,790 | 0,515 | 0,235 | 0,118 | 0,648 | 0,499 | 0,290 | 0,165 |
| **30** | | **1.5** | **Theo.** | **0,817** | **0,602** | **0,263** | **0,098** | **0,841** | **0,594** | **0,251** | **0,102** | **0,748** | **0,600** | **0,341** | **0,165** |
|  | |  | Obs. | 0,796 | 0,600 | 0,292 | 0,126 | 0,833 | 0,614 | 0,295 | 0,133 | 0,731 | 0,598 | 0,362 | 0,192 |
| **30** | | **2** | **Theo.** | **0,889** | **0,675** | **0,260** | **0,070** | **0,864** | **0,666** | **0,309** | **0,119** | **0,797** | **0,671** | **0,410** | **0,194** |
|  | |  | Obs. | 0,869 | 0,668 | 0,287 | 0,097 | 0,854 | 0,680 | 0,349 | 0,151 | 0,775 | 0,665 | 0,423 | 0,218 |
| **40** | | **0.5** | **Theo.** | **0,463** | **0,404** | **0,315** | **0,256** | **0,796** | **0,395** | **0,145** | **0,074** | **0,591** | **0,400** | **0,202** | **0,112** |
|  | |  | Obs. | 0,477 | 0,422 | 0,339 | 0,280 | 0,785 | 0,438 | 0,197 | 0,108 | 0,591 | 0,421 | 0,242 | 0,147 |
| **40** | | **1** | **Theo.** | **0,808** | **0,621** | **0,334** | **0,164** | **0,904** | **0,615** | **0,239** | **0,097** | **0,805** | **0,621** | **0,330** | **0,156** |
|  | |  | Obs. | 0,787 | 0,618 | 0,357 | 0,192 | 0,891 | 0,627 | 0,282 | 0,128 | 0,784 | 0,617 | 0,353 | 0,185 |
| **40** | | **1.5** | **Theo.** | **0,919** | **0,740** | **0,346** | **0,119** | **0,935** | **0,734** | **0,326** | **0,121** | **0,878** | **0,739** | **0,432** | **0,198** |
|  | |  | Obs. | 0,898 | 0,726 | 0,366 | 0,147 | 0,923 | 0,735 | 0,362 | 0,151 | 0,855 | 0,725 | 0,445 | 0,222 |
| **40** | | **2** | **Theo.** | **0,958** | **0,808** | **0,353** | **0,091** | **0,949** | **0,802** | **0,404** | **0,145** | **0,912** | **0,805** | **0,516** | **0,236** |
|  | |  | Obs. | 0,943 | 0,791 | 0,372 | 0,117 | 0,936 | 0,799 | 0,434 | 0,176 | 0,888 | 0,789 | 0,520 | 0,257 |
| **50** | | **0.5** | **Theo.** | **0,595** | **0,492** | **0,358** | **0,270** | **0,884** | **0,484** | **0,171** | **0,080** | **0,716** | **0,489** | **0,240** | **0,124** |
|  | |  | Obs. | 0,596 | 0,503 | 0,380 | 0,293 | 0,868 | 0,511 | 0,221 | 0,113 | 0,705 | 0,500 | 0,276 | 0,158 |
| **50** | | **1** | **Theo.** | **0,900** | **0,727** | **0,400** | **0,186** | **0,959** | **0,722** | **0,293** | **0,110** | **0,899** | **0,726** | **0,396** | **0,179** |
|  | |  | Obs. | 0,878 | 0,714 | 0,416 | 0,211 | 0,947 | 0,720 | 0,330 | 0,140 | 0,877 | 0,714 | 0,412 | 0,205 |
| **50** | | **1.5** | **Theo.** | **0,967** | **0,836** | **0,426** | **0,142** | **0,976** | **0,832** | **0,401** | **0,141** | **0,946** | **0,835** | **0,517** | **0,229** |
|  | |  | Obs. | 0,953 | 0,819 | 0,439 | 0,168 | 0,966 | 0,824 | 0,429 | 0,170 | 0,928 | 0,819 | 0,521 | 0,251 |
| **50** | | **2** | **Theo.** | **0,986** | **0,891** | **0,443** | **0,112** | **0,982** | **0,888** | **0,493** | **0,171** | **0,965** | **0,890** | **0,608** | **0,276** |
|  | |  | Obs. | 0,978 | 0,874 | 0,453 | 0,138 | 0,974 | 0,879 | 0,513 | 0,201 | 0,949 | 0,873 | 0,605 | 0,295 |
| **100** | | **0.5** | **Theo.** | **0,948** | **0,810** | **0,550** | **0,341** | **0,996** | **0,804** | **0,310** | **0,111** | **0,975** | **0,809** | **0,421** | **0,182** |
|  | |  | Obs. | 0,932 | 0,800 | 0,555 | 0,357 | 0,992 | 0,789 | 0,344 | 0,141 | 0,964 | 0,793 | 0,437 | 0,210 |
| **100** | | **1** | **Theo.** | **0,998** | **0,962** | **0,900** | **0,291** | **1,000** | **0,961** | **0,600** | **0,178** | **0,998** | **0,962** | **0,900** | **0,287** |
|  | |  | Obs. | 0,996 | 0,951 | 0,662 | 0,310 | 0,999 | 0,950 | 0,552 | 0,204 | 0,996 | 0,951 | 0,660 | 0,306 |
| **100** | | **1.5** | **Theo.** | **1,000** | **0,989** | **0,736** | **0,262** | **1,000** | **0,989** | **0,705** | **0,247** | **1,000** | **0,989** | **0,805** | **0,381** |
|  | |  | Obs. | 1,000 | 0,984 | 0,726 | 0,280 | 1,000 | 0,985 | 0,703 | 0,270 | 0,999 | 0,984 | 0,794 | 0,393 |
| **100** | | **2** | **Theo.** | **1,000** | **0,996** | **0,783** | **0,238** | **1,000** | **0,996** | **0,811** | **0,312** | **1,000** | **0,996** | **0,884** | **0,464** |
|  | |  | Obs. | 1,000 | 0,994 | 0,769 | 0,256 | 1,000 | 0,994 | 0,803 | 0,332 | 0,999 | 0,994 | 0,872 | 0,470 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.6a  *Comparison between observed and expected power, when nominal alpha risk = 5%, two groups are compared, one sample is extracted from a chi-square distribution with 2 degrees of freedom, and one sample is extracted from a right skewed distribution.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,265** | **0,239** | **0,206** | **0,192** | **0,419** | **0,232** | **0,107** | **0,065** | **0,419** | **0,232** | **0,107** | **0,065** |
|  | |  | Obs. | 0,358 | 0,275 | 0,183 | 0,174 | 0,468 | 0,211 | 0,069 | 0,053 | 0,468 | 0,211 | 0,069 | 0,053 |
| **20** | | **1** | **Theo.** | **0,498** | **0,338** | **0,168** | **0,089** | **0,489** | **0,337** | **0,162** | **0,082** | **0,489** | **0,337** | **0,162** | **0,082** |
|  | |  | Obs. | 0,541 | 0,371 | 0,143 | 0,068 | 0,534 | 0,370 | 0,135 | 0,061 | 0,534 | 0,370 | 0,135 | 0,061 |
| **20** | | **1.5** | **Theo.** | **0,618** | **0,397** | **0,146** | **0,050** | **0,513** | **0,394** | **0,207** | **0,097** | **0,513** | **0,394** | **0,207** | **0,097** |
|  | |  | Obs. | 0,632 | 0,429 | 0,123 | 0,032 | 0,554 | 0,441 | 0,199 | 0,075 | 0,554 | 0,441 | 0,199 | 0,075 |
| **20** | | **2** | **Theo.** | **0,686** | **0,435** | **0,131** | **0,031** | **0,525** | **0,428** | **0,245** | **0,113** | **0,525** | **0,428** | **0,245** | **0,113** |
|  | |  | Obs. | 0,687 | 0,466 | 0,108 | 0,017 | 0,564 | 0,478 | 0,252 | 0,093 | 0,564 | 0,478 | 0,252 | 0,093 |
| **30** | | **0.5** | **Theo.** | **0,414** | **0,339** | **0,250** | **0,201** | **0,588** | **0,332** | **0,140** | **0,073** | **0,588** | **0,332** | **0,140** | **0,073** |
|  | |  | Obs. | 0,468 | 0,366 | 0,230 | 0,181 | 0,603 | 0,325 | 0,099 | 0,055 | 0,603 | 0,325 | 0,099 | 0,055 |
| **30** | | **1** | **Theo.** | **0,673** | **0,478** | **0,227** | **0,105** | **0,667** | **0,478** | **0,223** | **0,099** | **0,667** | **0,478** | **0,223** | **0,099** |
|  | |  | Obs. | 0,668 | 0,499 | 0,207 | 0,080 | 0,663 | 0,498 | 0,201 | 0,075 | 0,663 | 0,498 | 0,201 | 0,075 |
| **30** | | **1.5** | **Theo.** | **0,778** | **0,553** | **0,214** | **0,064** | **0,695** | **0,551** | **0,291** | **0,124** | **0,695** | **0,551** | **0,291** | **0,124** |
|  | |  | Obs. | 0,757 | 0,570 | 0,194 | 0,044 | 0,683 | 0,568 | 0,287 | 0,101 | 0,683 | 0,568 | 0,287 | 0,101 |
| **30** | | **2** | **Theo.** | **0,832** | **0,600** | **0,203** | **0,043** | **0,710** | **0,594** | **0,347** | **0,147** | **0,710** | **0,594** | **0,347** | **0,147** |
|  | |  | Obs. | 0,804 | 0,614 | 0,184 | 0,026 | 0,693 | 0,606 | 0,354 | 0,127 | 0,693 | 0,606 | 0,354 | 0,127 |
| **40** | | **0.5** | **Theo.** | **0,553** | **0,435** | **0,294** | **0,214** | **0,718** | **0,429** | **0,173** | **0,082** | **0,718** | **0,429** | **0,173** | **0,082** |
|  | |  | Obs. | 0,568 | 0,452 | 0,276 | 0,193 | 0,709 | 0,429 | 0,134 | 0,060 | 0,709 | 0,429 | 0,134 | 0,060 |
| **40** | | **1** | **Theo.** | **0,797** | **0,599** | **0,288** | **0,121** | **0,794** | **0,598** | **0,285** | **0,116** | **0,794** | **0,598** | **0,285** | **0,116** |
|  | |  | Obs. | 0,767 | 0,607 | 0,272 | 0,096 | 0,763 | 0,607 | 0,267 | 0,092 | 0,763 | 0,607 | 0,267 | 0,092 |
| **40** | | **1.5** | **Theo.** | **0,879** | **0,679** | **0,284** | **0,080** | **0,820** | **0,677** | **0,373** | **0,149** | **0,820** | **0,677** | **0,373** | **0,149** |
|  | |  | Obs. | 0,844 | 0,684 | 0,269 | 0,058 | 0,782 | 0,676 | 0,371 | 0,127 | 0,782 | 0,676 | 0,371 | 0,127 |
| **40** | | **2** | **Theo.** | **0,914** | **0,726** | **0,278** | **0,056** | **0,833** | **0,722** | **0,440** | **0,181** | **0,833** | **0,722** | **0,440** | **0,181** |
|  | |  | Obs. | 0,881 | 0,728 | 0,266 | 0,038 | 0,790 | 0,710 | 0,447 | 0,163 | 0,790 | 0,710 | 0,447 | 0,163 |
| **50** | | **0.5** | **Theo.** | **0,670** | **0,522** | **0,337** | **0,226** | **0,813** | **0,516** | **0,208** | **0,091** | **0,813** | **0,516** | **0,208** | **0,091** |
|  | |  | Obs. | 0,658 | 0,530 | 0,321 | 0,205 | 0,793 | 0,521 | 0,170 | 0,067 | 0,793 | 0,521 | 0,170 | 0,067 |
| **50** | | **1** | **Theo.** | **0,879** | **0,697** | **0,348** | **0,139** | **0,877** | **0,697** | **0,345** | **0,135** | **0,877** | **0,697** | **0,345** | **0,135** |
|  | |  | Obs. | 0,842 | 0,696 | 0,335 | 0,114 | 0,840 | 0,696 | 0,331 | 0,109 | 0,840 | 0,696 | 0,331 | 0,109 |
| **50** | | **1.5** | **Theo.** | **0,935** | **0,776** | **0,353** | **0,097** | **0,897** | **0,775** | **0,449** | **0,176** | **0,897** | **0,775** | **0,449** | **0,176** |
|  | |  | Obs. | 0,902 | 0,771 | 0,343 | 0,075 | 0,853 | 0,760 | 0,449 | 0,155 | 0,853 | 0,760 | 0,449 | 0,155 |
| **50** | | **2** | **Theo.** | **0,957** | **0,818** | **0,356** | **0,071** | **0,906** | **0,815** | **0,527** | **0,215** | **0,906** | **0,815** | **0,527** | **0,215** |
|  | |  | Obs. | 0,929 | 0,813 | 0,348 | 0,052 | 0,860 | 0,792 | 0,533 | 0,198 | 0,860 | 0,792 | 0,533 | 0,198 |
| **100** | | **0.5** | **Theo.** | **0,950** | **0,818** | **0,525** | **0,294** | **0,982** | **0,815** | **0,375** | **0,137** | **0,982** | **0,815** | **0,375** | **0,137** |
|  | |  | Obs. | 0,918 | 0,809 | 0,521 | 0,274 | 0,969 | 0,825 | 0,355 | 0,110 | 0,969 | 0,825 | 0,355 | 0,110 |
| **100** | | **1** | **Theo.** | **0,994** | **0,941** | **0,604** | **0,228** | **0,994** | **0,941** | **0,603** | **0,225** | **0,994** | **0,941** | **0,603** | **0,225** |
|  | |  | Obs. | 0,982 | 0,932 | 0,608 | 0,206 | 0,982 | 0,932 | 0,606 | 0,203 | 0,982 | 0,932 | 0,606 | 0,203 |
| **100** | | **1.5** | **Theo.** | **0,998** | **0,971** | **0,651** | **0,188** | **0,996** | **0,971** | **0,739** | **0,307** | **0,996** | **0,971** | **0,739** | **0,307** |
|  | |  | Obs. | 0,993 | 0,963 | 0,659 | 0,169 | 0,985 | 0,957 | 0,744 | 0,293 | 0,985 | 0,957 | 0,744 | 0,293 |
| **100** | | **2** | **Theo.** | **0,999** | **0,982** | **0,683** | **0,162** | **0,997** | **0,982** | **0,820** | **0,382** | **0,997** | **0,982** | **0,820** | **0,382** |
|  | |  | Obs. | 0,996 | 0,977 | 0,692 | 0,142 | 0,987 | 0,969 | 0,821 | 0,374 | 0,987 | 0,969 | 0,821 | 0,374 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.6b  *Comparison between observed and expected power, when nominal alpha risk = 5%, two groups are compared, one sample is extracted from a chi-square distribution with 2 degrees of freedom, and one sample is extracted from a right skewed distribution.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,192** | **0,214** | **0,220** | **0,232** | **0,463** | **0,209** | **0,095** | **0,062** | **0,282** | **0,209** | **0,124** | **0,086** |
|  | |  | Obs. | 0,267 | 0,238 | 0,198 | 0,213 | 0,554 | 0,202 | 0,069 | 0,052 | 0,340 | 0,199 | 0,085 | 0,070 |
| **20** | | **1** | **Theo.** | **0,452** | **0,338** | **0,196** | **0,124** | **0,593** | **0,329** | **0,136** | **0,073** | **0,443** | **0,336** | **0,188** | **0,111** |
|  | |  | Obs. | 0,500 | 0,362 | 0,172 | 0,100 | 0,678 | 0,387 | 0,121 | 0,057 | 0,491 | 0,358 | 0,161 | 0,086 |
| **20** | | **1.5** | **Theo.** | **0,627** | **0,424** | **0,181** | **0,076** | **0,647** | **0,413** | **0,176** | **0,083** | **0,532** | **0,421** | **0,245** | **0,132** |
|  | |  | Obs. | 0,640 | 0,448 | 0,155 | 0,054 | 0,718 | 0,498 | 0,179 | 0,068 | 0,560 | 0,450 | 0,230 | 0,108 |
| **20** | | **2** | **Theo.** | **0,732** | **0,487** | **0,169** | **0,050** | **0,677** | **0,472** | **0,213** | **0,093** | **0,586** | **0,481** | **0,292** | **0,151** |
|  | |  | Obs. | 0,725 | 0,510 | 0,143 | 0,032 | 0,737 | 0,565 | 0,234 | 0,082 | 0,600 | 0,507 | 0,289 | 0,129 |
| **30** | | **0.5** | **Theo.** | **0,320** | **0,310** | **0,267** | **0,242** | **0,657** | **0,303** | **0,118** | **0,068** | **0,440** | **0,305** | **0,162** | **0,099** |
|  | |  | Obs. | 0,379 | 0,327 | 0,249 | 0,223 | 0,715 | 0,306 | 0,091 | 0,053 | 0,477 | 0,302 | 0,124 | 0,077 |
| **30** | | **1** | **Theo.** | **0,659** | **0,490** | **0,267** | **0,143** | **0,793** | **0,482** | **0,187** | **0,085** | **0,654** | **0,489** | **0,261** | **0,133** |
|  | |  | Obs. | 0,658 | 0,504 | 0,245 | 0,119 | 0,817 | 0,536 | 0,175 | 0,068 | 0,652 | 0,502 | 0,237 | 0,108 |
| **30** | | **1.5** | **Theo.** | **0,817** | **0,602** | **0,263** | **0,098** | **0,841** | **0,594** | **0,251** | **0,102** | **0,748** | **0,600** | **0,341** | **0,165** |
|  | |  | Obs. | 0,791 | 0,613 | 0,243 | 0,073 | 0,848 | 0,652 | 0,258 | 0,087 | 0,726 | 0,607 | 0,333 | 0,141 |
| **30** | | **2** | **Theo.** | **0,889** | **0,675** | **0,260** | **0,070** | **0,864** | **0,666** | **0,309** | **0,119** | **0,797** | **0,671** | **0,410** | **0,194** |
|  | |  | Obs. | 0,859 | 0,684 | 0,240 | 0,048 | 0,863 | 0,717 | 0,334 | 0,108 | 0,764 | 0,670 | 0,409 | 0,172 |
| **40** | | **0.5** | **Theo.** | **0,463** | **0,404** | **0,315** | **0,256** | **0,796** | **0,395** | **0,145** | **0,074** | **0,591** | **0,400** | **0,202** | **0,112** |
|  | |  | Obs. | 0,493 | 0,415 | 0,297 | 0,236 | 0,828 | 0,409 | 0,116 | 0,057 | 0,601 | 0,401 | 0,165 | 0,087 |
| **40** | | **1** | **Theo.** | **0,808** | **0,621** | **0,334** | **0,164** | **0,904** | **0,615** | **0,239** | **0,097** | **0,805** | **0,621** | **0,330** | **0,156** |
|  | |  | Obs. | 0,780 | 0,626 | 0,319 | 0,140 | 0,903 | 0,660 | 0,231 | 0,080 | 0,777 | 0,625 | 0,313 | 0,132 |
| **40** | | **1.5** | **Theo.** | **0,919** | **0,740** | **0,346** | **0,119** | **0,935** | **0,734** | **0,326** | **0,121** | **0,878** | **0,739** | **0,432** | **0,198** |
|  | |  | Obs. | 0,887 | 0,740 | 0,332 | 0,095 | 0,924 | 0,769 | 0,338 | 0,107 | 0,840 | 0,730 | 0,428 | 0,175 |
| **40** | | **2** | **Theo.** | **0,958** | **0,808** | **0,353** | **0,091** | **0,949** | **0,802** | **0,404** | **0,145** | **0,912** | **0,805** | **0,516** | **0,236** |
|  | |  | Obs. | 0,932 | 0,805 | 0,341 | 0,068 | 0,933 | 0,824 | 0,431 | 0,135 | 0,870 | 0,788 | 0,517 | 0,216 |
| **50** | | **0.5** | **Theo.** | **0,595** | **0,492** | **0,358** | **0,270** | **0,884** | **0,484** | **0,171** | **0,080** | **0,716** | **0,489** | **0,240** | **0,124** |
|  | |  | Obs. | 0,600 | 0,499 | 0,342 | 0,251 | 0,900 | 0,508 | 0,142 | 0,062 | 0,707 | 0,493 | 0,206 | 0,098 |
| **50** | | **1** | **Theo.** | **0,900** | **0,727** | **0,400** | **0,186** | **0,959** | **0,722** | **0,293** | **0,110** | **0,899** | **0,726** | **0,396** | **0,179** |
|  | |  | Obs. | 0,866 | 0,726 | 0,388 | 0,161 | 0,951 | 0,759 | 0,287 | 0,092 | 0,864 | 0,725 | 0,383 | 0,154 |
| **50** | | **1.5** | **Theo.** | **0,967** | **0,836** | **0,426** | **0,142** | **0,976** | **0,832** | **0,401** | **0,141** | **0,946** | **0,835** | **0,517** | **0,229** |
|  | |  | Obs. | 0,942 | 0,832 | 0,417 | 0,118 | 0,964 | 0,853 | 0,416 | 0,127 | 0,912 | 0,823 | 0,515 | 0,208 |
| **50** | | **2** | **Theo.** | **0,986** | **0,891** | **0,443** | **0,112** | **0,982** | **0,888** | **0,493** | **0,171** | **0,965** | **0,890** | **0,608** | **0,276** |
|  | |  | Obs. | 0,969 | 0,885 | 0,439 | 0,090 | 0,969 | 0,895 | 0,522 | 0,163 | 0,933 | 0,869 | 0,610 | 0,260 |
| **100** | | **0.5** | **Theo.** | **0,948** | **0,810** | **0,550** | **0,341** | **0,996** | **0,804** | **0,310** | **0,111** | **0,975** | **0,809** | **0,421** | **0,182** |
|  | |  | Obs. | 0,922 | 0,805 | 0,545 | 0,326 | 0,996 | 0,838 | 0,290 | 0,091 | 0,961 | 0,815 | 0,406 | 0,156 |
| **100** | | **1** | **Theo.** | **0,998** | **0,962** | **0,900** | **0,291** | **1,000** | **0,961** | **0,600** | **0,178** | **0,998** | **0,962** | **0,900** | **0,287** |
|  | |  | Obs. | 0,994 | 0,958 | 0,673 | 0,273 | 0,999 | 0,969 | 0,555 | 0,162 | 0,994 | 0,957 | 0,671 | 0,268 |
| **100** | | **1.5** | **Theo.** | **1,000** | **0,989** | **0,736** | **0,262** | **1,000** | **0,989** | **0,705** | **0,247** | **1,000** | **0,989** | **0,805** | **0,381** |
|  | |  | Obs. | 0,999 | 0,987 | 0,747 | 0,243 | 0,999 | 0,989 | 0,728 | 0,235 | 0,998 | 0,985 | 0,812 | 0,370 |
| **100** | | **2** | **Theo.** | **1,000** | **0,996** | **0,783** | **0,238** | **1,000** | **0,996** | **0,811** | **0,312** | **1,000** | **0,996** | **0,884** | **0,464** |
|  | |  | Obs. | 1,000 | 0,995 | 0,795 | 0,220 | 1,000 | 0,995 | 0,831 | 0,309 | 0,999 | 0,993 | 0,888 | 0,459 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.7a  *Comparison between observed and expected power, when nominal alpha risk = 5%, two groups are compared, one sample is extracted from a chi-square distribution with 2 degrees of freedom, and one is extracted from a left skewed distribution.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,265** | **0,239** | **0,206** | **0,192** | **0,419** | **0,232** | **0,107** | **0,065** | **0,419** | **0,232** | **0,107** | **0,065** |
|  | |  | Obs. | 0,100 | 0,305 | 0,252 | 0,226 | 0,300 | 0,287 | 0,162 | 0,107 | 0,300 | 0,287 | 0,162 | 0,107 |
| **20** | | **1** | **Theo.** | **0,498** | **0,338** | **0,168** | **0,089** | **0,489** | **0,337** | **0,162** | **0,082** | **0,489** | **0,337** | **0,162** | **0,082** |
|  | |  | Obs. | 0,538 | 0,387 | 0,212 | 0,124 | 0,531 | 0,385 | 0,207 | 0,117 | 0,531 | 0,385 | 0,207 | 0,117 |
| **20** | | **1.5** | **Theo.** | **0,618** | **0,397** | **0,146** | **0,050** | **0,513** | **0,394** | **0,207** | **0,097** | **0,513** | **0,394** | **0,207** | **0,097** |
|  | |  | Obs. | 0,629 | 0,435 | 0,188 | 0,079 | 0,553 | 0,442 | 0,249 | 0,129 | 0,553 | 0,442 | 0,249 | 0,129 |
| **20** | | **2** | **Theo.** | **0,686** | **0,435** | **0,131** | **0,031** | **0,525** | **0,428** | **0,245** | **0,113** | **0,525** | **0,428** | **0,245** | **0,113** |
|  | |  | Obs. | 0,681 | 0,466 | 0,169 | 0,054 | 0,562 | 0,476 | 0,286 | 0,142 | 0,562 | 0,476 | 0,286 | 0,142 |
| **30** | | **0.5** | **Theo.** | **0,414** | **0,339** | **0,250** | **0,201** | **0,588** | **0,332** | **0,140** | **0,073** | **0,588** | **0,332** | **0,140** | **0,073** |
|  | |  | Obs. | 0,469 | 0,385 | 0,288 | 0,231 | 0,595 | 0,371 | 0,189 | 0,111 | 0,595 | 0,371 | 0,189 | 0,111 |
| **30** | | **1** | **Theo.** | **0,673** | **0,478** | **0,227** | **0,105** | **0,667** | **0,478** | **0,223** | **0,099** | **0,667** | **0,478** | **0,223** | **0,099** |
|  | |  | Obs. | 0,664 | 0,500 | 0,265 | 0,137 | 0,660 | 0,499 | 0,261 | 0,131 | 0,660 | 0,499 | 0,261 | 0,131 |
| **30** | | **1.5** | **Theo.** | **0,778** | **0,553** | **0,214** | **0,064** | **0,695** | **0,551** | **0,291** | **0,124** | **0,695** | **0,551** | **0,291** | **0,124** |
|  | |  | Obs. | 0,753 | 0,562 | 0,249 | 0,092 | 0,682 | 0,563 | 0,322 | 0,153 | 0,682 | 0,563 | 0,322 | 0,153 |
| **30** | | **2** | **Theo.** | **0,832** | **0,600** | **0,203** | **0,043** | **0,710** | **0,594** | **0,347** | **0,147** | **0,710** | **0,594** | **0,347** | **0,147** |
|  | |  | Obs. | 0,800 | 0,604 | 0,235 | 0,065 | 0,691 | 0,601 | 0,373 | 0,174 | 0,691 | 0,601 | 0,373 | 0,174 |
| **40** | | **0.5** | **Theo.** | **0,553** | **0,435** | **0,294** | **0,214** | **0,718** | **0,429** | **0,173** | **0,082** | **0,718** | **0,429** | **0,173** | **0,082** |
|  | |  | Obs. | 0,568 | 0,463 | 0,327 | 0,241 | 0,698 | 0,452 | 0,219 | 0,118 | 0,698 | 0,452 | 0,219 | 0,118 |
| **40** | | **1** | **Theo.** | **0,797** | **0,599** | **0,288** | **0,121** | **0,794** | **0,598** | **0,285** | **0,116** | **0,794** | **0,598** | **0,285** | **0,116** |
|  | |  | Obs. | 0,764 | 0,599 | 0,318 | 0,151 | 0,760 | 0,598 | 0,315 | 0,146 | 0,760 | 0,598 | 0,315 | 0,146 |
| **40** | | **1.5** | **Theo.** | **0,879** | **0,679** | **0,284** | **0,080** | **0,820** | **0,677** | **0,373** | **0,149** | **0,820** | **0,677** | **0,373** | **0,149** |
|  | |  | Obs. | 0,840 | 0,670 | 0,312 | 0,107 | 0,779 | 0,667 | 0,394 | 0,176 | 0,779 | 0,667 | 0,394 | 0,176 |
| **40** | | **2** | **Theo.** | **0,914** | **0,726** | **0,278** | **0,056** | **0,833** | **0,722** | **0,440** | **0,181** | **0,833** | **0,722** | **0,440** | **0,181** |
|  | |  | Obs. | 0,878 | 0,714 | 0,305 | 0,079 | 0,788 | 0,705 | 0,457 | 0,206 | 0,788 | 0,705 | 0,457 | 0,206 |
| **50** | | **0.5** | **Theo.** | **0,670** | **0,522** | **0,337** | **0,226** | **0,813** | **0,516** | **0,208** | **0,091** | **0,813** | **0,516** | **0,208** | **0,091** |
|  | |  | Obs. | 0,656 | 0,534 | 0,364 | 0,252 | 0,780 | 0,525 | 0,249 | 0,126 | 0,780 | 0,525 | 0,249 | 0,126 |
| **50** | | **1** | **Theo.** | **0,879** | **0,697** | **0,348** | **0,139** | **0,877** | **0,697** | **0,345** | **0,135** | **0,877** | **0,697** | **0,345** | **0,135** |
|  | |  | Obs. | 0,837 | 0,683 | 0,372 | 0,168 | 0,835 | 0,683 | 0,369 | 0,164 | 0,835 | 0,683 | 0,369 | 0,164 |
| **50** | | **1.5** | **Theo.** | **0,935** | **0,776** | **0,353** | **0,097** | **0,897** | **0,775** | **0,449** | **0,176** | **0,897** | **0,775** | **0,449** | **0,176** |
|  | |  | Obs. | 0,899 | 0,755 | 0,374 | 0,123 | 0,852 | 0,750 | 0,462 | 0,201 | 0,852 | 0,750 | 0,462 | 0,201 |
| **50** | | **2** | **Theo.** | **0,957** | **0,818** | **0,356** | **0,071** | **0,906** | **0,815** | **0,527** | **0,215** | **0,906** | **0,815** | **0,527** | **0,215** |
|  | |  | Obs. | 0,927 | 0,798 | 0,374 | 0,093 | 0,860 | 0,786 | 0,533 | 0,238 | 0,860 | 0,786 | 0,533 | 0,238 |
| **100** | | **0.5** | **Theo.** | **0,950** | **0,818** | **0,525** | **0,294** | **0,982** | **0,815** | **0,375** | **0,137** | **0,982** | **0,815** | **0,375** | **0,137** |
|  | |  | Obs. | 0,914 | 0,796 | 0,530 | 0,313 | 0,964 | 0,793 | 0,395 | 0,166 | 0,964 | 0,793 | 0,395 | 0,166 |
| **100** | | **1** | **Theo.** | **0,994** | **0,941** | **0,604** | **0,228** | **0,994** | **0,941** | **0,603** | **0,225** | **0,994** | **0,941** | **0,603** | **0,225** |
|  | |  | Obs. | 0,981 | 0,919 | 0,602 | 0,249 | 0,981 | 0,919 | 0,600 | 0,247 | 0,981 | 0,919 | 0,600 | 0,247 |
| **100** | | **1.5** | **Theo.** | **0,998** | **0,971** | **0,651** | **0,188** | **0,996** | **0,971** | **0,739** | **0,307** | **0,996** | **0,971** | **0,739** | **0,307** |
|  | |  | Obs. | 0,992 | 0,956 | 0,645 | 0,211 | 0,985 | 0,952 | 0,727 | 0,323 | 0,985 | 0,952 | 0,727 | 0,323 |
| **100** | | **2** | **Theo.** | **0,999** | **0,982** | **0,683** | **0,162** | **0,997** | **0,982** | **0,820** | **0,382** | **0,997** | **0,982** | **0,820** | **0,382** |
|  | |  | Obs. | 0,996 | 0,971 | 0,674 | 0,182 | 0,986 | 0,966 | 0,805 | 0,393 | 0,986 | 0,966 | 0,805 | 0,393 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.7b  *Comparison between observed and expected power, when nominal alpha risk = 5%, three groups are compared, two samples are extracted from a chi-square distribution with 2 degrees of freedom, and one is extracted from a left skewed distribution.* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,192** | **0,214** | **0,220** | **0,232** | **0,463** | **0,209** | **0,095** | **0,062** | **0,282** | **0,209** | **0,124** | **0,086** |
|  | |  | Obs. | 0,273 | 0,266 | 0,259 | 0,261 | 0,552 | 0,302 | 0,158 | 0,103 | 0,349 | 0,260 | 0,176 | 0,128 |
| **20** | | **1** | **Theo.** | **0,452** | **0,338** | **0,196** | **0,124** | **0,593** | **0,329** | **0,136** | **0,073** | **0,443** | **0,336** | **0,188** | **0,111** |
|  | |  | Obs. | 0,499 | 0,379 | 0,238 | 0,157 | 0,668 | 0,420 | 0,201 | 0,108 | 0,490 | 0,375 | 0,230 | 0,144 |
| **20** | | **1.5** | **Theo.** | **0,627** | **0,424** | **0,181** | **0,076** | **0,647** | **0,413** | **0,176** | **0,083** | **0,532** | **0,421** | **0,245** | **0,132** |
|  | |  | Obs. | 0,636 | 0,454 | 0,221 | 0,108 | 0,712 | 0,504 | 0,244 | 0,120 | 0,559 | 0,454 | 0,279 | 0,163 |
| **20** | | **2** | **Theo.** | **0,732** | **0,487** | **0,169** | **0,050** | **0,677** | **0,472** | **0,213** | **0,093** | **0,586** | **0,481** | **0,292** | **0,151** |
|  | |  | Obs. | 0,721 | 0,508 | 0,207 | 0,078 | 0,734 | 0,562 | 0,284 | 0,131 | 0,600 | 0,507 | 0,321 | 0,179 |
| **30** | | **0.5** | **Theo.** | **0,320** | **0,310** | **0,267** | **0,242** | **0,657** | **0,303** | **0,118** | **0,068** | **0,440** | **0,305** | **0,162** | **0,099** |
|  | |  | Obs. | 0,384 | 0,350 | 0,300 | 0,269 | 0,691 | 0,379 | 0,179 | 0,104 | 0,479 | 0,345 | 0,208 | 0,137 |
| **30** | | **1** | **Theo.** | **0,659** | **0,490** | **0,267** | **0,143** | **0,793** | **0,482** | **0,187** | **0,085** | **0,654** | **0,489** | **0,261** | **0,133** |
|  | |  | Obs. | 0,655 | 0,507 | 0,298 | 0,175 | 0,805 | 0,541 | 0,247 | 0,120 | 0,650 | 0,505 | 0,293 | 0,166 |
| **30** | | **1.5** | **Theo.** | **0,817** | **0,602** | **0,263** | **0,098** | **0,841** | **0,594** | **0,251** | **0,102** | **0,748** | **0,600** | **0,341** | **0,165** |
|  | |  | Obs. | 0,785 | 0,604 | 0,294 | 0,126 | 0,841 | 0,642 | 0,311 | 0,137 | 0,722 | 0,603 | 0,365 | 0,192 |
| **30** | | **2** | **Theo.** | **0,889** | **0,675** | **0,260** | **0,070** | **0,864** | **0,666** | **0,309** | **0,119** | **0,797** | **0,671** | **0,410** | **0,194** |
|  | |  | Obs. | 0,855 | 0,668 | 0,290 | 0,097 | 0,859 | 0,705 | 0,370 | 0,156 | 0,763 | 0,664 | 0,426 | 0,219 |
| **40** | | **0.5** | **Theo.** | **0,463** | **0,404** | **0,315** | **0,256** | **0,796** | **0,395** | **0,145** | **0,074** | **0,591** | **0,400** | **0,202** | **0,112** |
|  | |  | Obs. | 0,496 | 0,430 | 0,340 | 0,280 | 0,797 | 0,453 | 0,202 | 0,109 | 0,598 | 0,425 | 0,242 | 0,147 |
| **40** | | **1** | **Theo.** | **0,808** | **0,621** | **0,334** | **0,164** | **0,904** | **0,615** | **0,239** | **0,097** | **0,805** | **0,621** | **0,330** | **0,156** |
|  | |  | Obs. | 0,777 | 0,619 | 0,359 | 0,193 | 0,892 | 0,646 | 0,294 | 0,131 | 0,773 | 0,618 | 0,354 | 0,186 |
| **40** | | **1.5** | **Theo.** | **0,919** | **0,740** | **0,346** | **0,119** | **0,935** | **0,734** | **0,326** | **0,121** | **0,878** | **0,739** | **0,432** | **0,198** |
|  | |  | Obs. | 0,882 | 0,723 | 0,368 | 0,147 | 0,919 | 0,750 | 0,378 | 0,155 | 0,836 | 0,720 | 0,447 | 0,222 |
| **40** | | **2** | **Theo.** | **0,958** | **0,808** | **0,353** | **0,091** | **0,949** | **0,802** | **0,404** | **0,145** | **0,912** | **0,805** | **0,516** | **0,236** |
|  | |  | Obs. | 0,929 | 0,787 | 0,373 | 0,117 | 0,930 | 0,809 | 0,451 | 0,182 | 0,868 | 0,780 | 0,521 | 0,257 |
| **50** | | **0.5** | **Theo.** | **0,595** | **0,492** | **0,358** | **0,270** | **0,884** | **0,484** | **0,171** | **0,080** | **0,716** | **0,489** | **0,240** | **0,124** |
|  | |  | Obs. | 0,601 | 0,508 | 0,380 | 0,293 | 0,871 | 0,524 | 0,226 | 0,114 | 0,701 | 0,503 | 0,276 | 0,157 |
| **50** | | **1** | **Theo.** | **0,900** | **0,727** | **0,400** | **0,186** | **0,959** | **0,722** | **0,293** | **0,110** | **0,899** | **0,726** | **0,396** | **0,179** |
|  | |  | Obs. | 0,862 | 0,712 | 0,417 | 0,212 | 0,943 | 0,733 | 0,340 | 0,143 | 0,860 | 0,711 | 0,413 | 0,206 |
| **50** | | **1.5** | **Theo.** | **0,967** | **0,836** | **0,426** | **0,142** | **0,976** | **0,832** | **0,401** | **0,141** | **0,946** | **0,835** | **0,517** | **0,229** |
|  | |  | Obs. | 0,939 | 0,812 | 0,439 | 0,168 | 0,961 | 0,831 | 0,441 | 0,174 | 0,910 | 0,809 | 0,522 | 0,251 |
| **50** | | **2** | **Theo.** | **0,986** | **0,891** | **0,443** | **0,112** | **0,982** | **0,888** | **0,493** | **0,171** | **0,965** | **0,890** | **0,608** | **0,276** |
|  | |  | Obs. | 0,968 | 0,867 | 0,455 | 0,138 | 0,968 | 0,881 | 0,528 | 0,207 | 0,931 | 0,861 | 0,605 | 0,295 |
| **100** | | **0.5** | **Theo.** | **0,948** | **0,810** | **0,550** | **0,341** | **0,996** | **0,804** | **0,310** | **0,111** | **0,975** | **0,809** | **0,421** | **0,182** |
|  | |  | Obs. | 0,918 | 0,794 | 0,554 | 0,358 | 0,991 | 0,793 | 0,348 | 0,143 | 0,955 | 0,789 | 0,436 | 0,210 |
| **100** | | **1** | **Theo.** | **0,998** | **0,962** | **0,900** | **0,291** | **1,000** | **0,961** | **0,600** | **0,178** | **0,998** | **0,962** | **0,900** | **0,287** |
|  | |  | Obs. | 0,993 | 0,946 | 0,660 | 0,310 | 0,999 | 0,950 | 0,559 | 0,208 | 0,993 | 0,946 | 0,659 | 0,306 |
| **100** | | **1.5** | **Theo.** | **1,000** | **0,989** | **0,736** | **0,262** | **1,000** | **0,989** | **0,705** | **0,247** | **1,000** | **0,989** | **0,805** | **0,381** |
|  | |  | Obs. | 0,999 | 0,981 | 0,725 | 0,280 | 0,999 | 0,983 | 0,709 | 0,273 | 0,997 | 0,981 | 0,792 | 0,392 |
| **100** | | **2** | **Theo.** | **1,000** | **0,996** | **0,783** | **0,238** | **1,000** | **0,996** | **0,811** | **0,312** | **1,000** | **0,996** | **0,884** | **0,464** |
|  | |  | Obs. | 1,000 | 0,992 | 0,768 | 0,257 | 1,000 | 0,993 | 0,808 | 0,339 | 0,999 | 0,991 | 0,870 | 0,471 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.8a  *Comparison between observed and expected power, when nominal alpha risk = 5%, two groups are compared and samples are extracted from double exponential distributions, where standard deviation is ..* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,265** | **0,239** | **0,206** | **0,192** | **0,419** | **0,232** | **0,107** | **0,065** | **0,419** | **0,232** | **0,107** | **0,065** |
|  | |  | Obs. |  | 0,153 |  | 0,178 | 0,256 | 0,152 | 0,081 | 0,054 | 0,256 | 0,152 | 0,081 | 0,054 |
| **20** | | **1** | **Theo.** | **0,498** | **0,338** | **0,168** | **0,089** | **0,489** | **0,337** | **0,162** | **0,082** | **0,489** | **0,337** | **0,162** | **0,082** |
|  | |  | Obs. | 0,307 | 0,206 | 0,147 | 0,072 | 0,299 | 0,204 | 0,111 | 0,066 | 0,299 | 0,204 | 0,111 | 0,066 |
| **20** | | **1.5** | **Theo.** | **0,618** | **0,397** | **0,146** | **0,050** | **0,513** | **0,394** | **0,207** | **0,097** | **0,513** | **0,394** | **0,207** | **0,097** |
|  | |  | Obs. |  | 0,236 |  | 0,036 | 0,317 | 0,235 | 0,133 | 0,075 | 0,317 | 0,235 | 0,133 | 0,075 |
| **20** | | **2** | **Theo.** | **0,686** | **0,435** | **0,131** | **0,031** | **0,525** | **0,428** | **0,245** | **0,113** | **0,525** | **0,428** | **0,245** | **0,113** |
|  | |  | Obs. |  | 0,256 |  | 0,019 | 0,328 | 0,257 | 0,152 | 0,082 | 0,328 | 0,257 | 0,152 | 0,082 |
| **30** | | **0.5** | **Theo.** | **0,414** | **0,339** | **0,250** | **0,201** | **0,588** | **0,332** | **0,140** | **0,073** | **0,588** | **0,332** | **0,140** | **0,073** |
|  | |  | Obs. |  | 0,205 |  | 0,182 | 0,355 | 0,206 | 0,100 | 0,060 | 0,355 | 0,206 | 0,100 | 0,060 |
| **30** | | **1** | **Theo.** | **0,673** | **0,478** | **0,227** | **0,105** | **0,667** | **0,478** | **0,223** | **0,099** | **0,667** | **0,478** | **0,223** | **0,099** |
|  | |  | Obs. | 0,419 | 0,281 | 0,195 | 0,080 | 0,414 | 0,280 | 0,142 | 0,075 | 0,414 | 0,280 | 0,142 | 0,075 |
| **30** | | **1.5** | **Theo.** | **0,778** | **0,553** | **0,214** | **0,064** | **0,695** | **0,551** | **0,291** | **0,124** | **0,695** | **0,551** | **0,291** | **0,124** |
|  | |  | Obs. |  | 0,327 |  | 0,042 | 0,437 | 0,327 | 0,175 | 0,088 | 0,437 | 0,327 | 0,175 | 0,088 |
| **30** | | **2** | **Theo.** | **0,832** | **0,600** | **0,203** | **0,043** | **0,710** | **0,594** | **0,347** | **0,147** | **0,710** | **0,594** | **0,347** | **0,147** |
|  | |  | Obs. |  | 0,355 |  | 0,025 | 0,450 | 0,356 | 0,203 | 0,099 | 0,450 | 0,356 | 0,203 | 0,099 |
| **40** | | **0.5** | **Theo.** | **0,553** | **0,435** | **0,294** | **0,214** | **0,718** | **0,429** | **0,173** | **0,082** | **0,718** | **0,429** | **0,173** | **0,082** |
|  | |  | Obs. |  | 0,256 |  | 0,189 | 0,448 | 0,258 | 0,118 | 0,066 | 0,448 | 0,258 | 0,118 | 0,066 |
| **40** | | **1** | **Theo.** | **0,797** | **0,599** | **0,288** | **0,121** | **0,794** | **0,598** | **0,285** | **0,116** | **0,794** | **0,598** | **0,285** | **0,116** |
|  | |  | Obs. | 0,521 | 0,355 | 0,242 | 0,089 | 0,517 | 0,355 | 0,173 | 0,085 | 0,517 | 0,355 | 0,173 | 0,085 |
| **40** | | **1.5** | **Theo.** | **0,879** | **0,679** | **0,284** | **0,080** | **0,820** | **0,677** | **0,373** | **0,149** | **0,820** | **0,677** | **0,373** | **0,149** |
|  | |  | Obs. |  | 0,412 |  | 0,049 | 0,544 | 0,412 | 0,217 | 0,101 | 0,544 | 0,412 | 0,217 | 0,101 |
| **40** | | **2** | **Theo.** | **0,914** | **0,726** | **0,278** | **0,056** | **0,833** | **0,722** | **0,440** | **0,181** | **0,833** | **0,722** | **0,440** | **0,181** |
|  | |  | Obs. |  | 0,449 |  | 0,030 | 0,559 | 0,449 | 0,255 | 0,116 | 0,559 | 0,449 | 0,255 | 0,116 |
| **50** | | **0.5** | **Theo.** | **0,670** | **0,522** | **0,337** | **0,226** | **0,813** | **0,516** | **0,208** | **0,091** | **0,813** | **0,516** | **0,208** | **0,091** |
|  | |  | Obs. | 0,366 | 0,306 | 0,235 | 0,195 | 0,532 | 0,307 | 0,136 | 0,072 | 0,532 | 0,307 | 0,136 | 0,072 |
| **50** | | **1** | **Theo.** | **0,879** | **0,697** | **0,348** | **0,139** | **0,877** | **0,697** | **0,345** | **0,135** | **0,877** | **0,697** | **0,345** | **0,135** |
|  | |  | Obs. | 0,610 | 0,426 | 0,207 | 0,097 | 0,607 | 0,426 | 0,204 | 0,094 | 0,607 | 0,426 | 0,204 | 0,094 |
| **50** | | **1.5** | **Theo.** | **0,935** | **0,776** | **0,353** | **0,097** | **0,897** | **0,775** | **0,449** | **0,176** | **0,897** | **0,775** | **0,449** | **0,176** |
|  | |  | Obs. | 0,719 | 0,491 | 0,188 | 0,057 | 0,636 | 0,491 | 0,260 | 0,114 | 0,636 | 0,491 | 0,260 | 0,114 |
| **50** | | **2** | **Theo.** | **0,957** | **0,818** | **0,356** | **0,071** | **0,906** | **0,815** | **0,527** | **0,215** | **0,906** | **0,815** | **0,527** | **0,215** |
|  | |  | Obs. | 0,774 | 0,532 | 0,174 | 0,037 | 0,649 | 0,533 | 0,305 | 0,134 | 0,649 | 0,533 | 0,305 | 0,134 |
| **100** | | **0.5** | **Theo.** | **0,950** | **0,818** | **0,525** | **0,294** | **0,982** | **0,815** | **0,375** | **0,137** | **0,982** | **0,815** | **0,375** | **0,137** |
|  | |  | Obs. | 0,682 | 0,533 | 0,344 | 0,229 | 0,818 | 0,533 | 0,222 | 0,095 | 0,818 | 0,533 | 0,222 | 0,095 |
| **100** | | **1** | **Theo.** | **0,994** | **0,941** | **0,604** | **0,228** | **0,994** | **0,941** | **0,603** | **0,225** | **0,994** | **0,941** | **0,603** | **0,225** |
|  | |  | Obs. | 0,880 | 0,703 | 0,356 | 0,141 | 0,880 | 0,703 | 0,355 | 0,139 | 0,880 | 0,703 | 0,355 | 0,139 |
| **100** | | **1.5** | **Theo.** | **0,998** | **0,971** | **0,651** | **0,188** | **0,996** | **0,971** | **0,739** | **0,307** | **0,996** | **0,971** | **0,739** | **0,307** |
|  | |  | Obs. | 0,935 | 0,780 | 0,360 | 0,098 | 0,899 | 0,779 | 0,456 | 0,180 | 0,899 | 0,779 | 0,456 | 0,180 |
| **100** | | **2** | **Theo.** | **0,999** | **0,982** | **0,683** | **0,162** | **0,997** | **0,982** | **0,820** | **0,382** | **0,997** | **0,982** | **0,820** | **0,382** |
|  | |  | Obs. | 0,956 | 0,820 | 0,361 | 0,072 | 0,908 | 0,819 | 0,532 | 0,220 | 0,908 | 0,819 | 0,532 | 0,220 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4.8b  *Comparison between observed and expected power, when nominal alpha risk = 5%, three groups are compared and samples are extracted from double exponential distributions, where standard deviation is ..* | | | | | | | | | | | | | | | |
|  | |  |  | **Test** | | | | | | | | | | | |
|  | |  |  | ***F*-test** | | | | ***W*-test** | | | | ***F\**-test** | | | |
| **n1** | **n-ratio** | | **SDR :** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** | **0.5** | **1** | **2** | **4** |
| **20** | | **0.5** | **Theo.** | **0,192** | **0,214** | **0,220** | **0,232** | **0,463** | **0,209** | **0,095** | **0,062** | **0,282** | **0,209** | **0,124** | **0,086** |
|  | |  | Obs. | 0,101 | 0,132 | 0,173 | 0,216 | 0,278 | 0,140 | 0,073 | 0,051 | 0,156 | 0,129 | 0,092 | 0,072 |
| **20** | | **1** | **Theo.** | **0,452** | **0,338** | **0,196** | **0,124** | **0,593** | **0,329** | **0,136** | **0,073** | **0,443** | **0,336** | **0,188** | **0,111** |
|  | |  | Obs. | 0,245 | 0,194 | 0,134 | 0,102 | 0,354 | 0,196 | 0,095 | 0,059 | 0,238 | 0,191 | 0,128 | 0,091 |
| **20** | | **1.5** | **Theo.** | **0,627** | **0,424** | **0,181** | **0,076** | **0,647** | **0,413** | **0,176** | **0,083** | **0,532** | **0,421** | **0,245** | **0,132** |
|  | |  | Obs. | 0,373 | 0,239 | 0,110 | 0,056 | 0,393 | 0,237 | 0,114 | 0,064 | 0,290 | 0,236 | 0,155 | 0,102 |
| **20** | | **2** | **Theo.** | **0,732** | **0,487** | **0,169** | **0,050** | **0,677** | **0,472** | **0,213** | **0,093** | **0,586** | **0,481** | **0,292** | **0,151** |
|  | |  | Obs. | 0,471 | 0,274 | 0,093 | 0,033 | 0,418 | 0,271 | 0,130 | 0,070 | 0,326 | 0,270 | 0,178 | 0,112 |
| **30** | | **0.5** | **Theo.** | **0,320** | **0,310** | **0,267** | **0,242** | **0,657** | **0,303** | **0,118** | **0,068** | **0,440** | **0,305** | **0,162** | **0,099** |
|  | |  | Obs. | 0,150 | 0,178 | 0,200 | 0,222 | 0,397 | 0,188 | 0,087 | 0,056 | 0,227 | 0,178 | 0,115 | 0,083 |
| **30** | | **1** | **Theo.** | **0,659** | **0,490** | **0,267** | **0,143** | **0,793** | **0,482** | **0,187** | **0,085** | **0,654** | **0,489** | **0,261** | **0,133** |
|  | |  | Obs. | 0,360 | 0,274 | 0,170 | 0,113 | 0,503 | 0,276 | 0,120 | 0,066 | 0,354 | 0,272 | 0,165 | 0,105 |
| **30** | | **1.5** | **Theo.** | **0,817** | **0,602** | **0,263** | **0,098** | **0,841** | **0,594** | **0,251** | **0,102** | **0,748** | **0,600** | **0,341** | **0,165** |
|  | |  | Obs. | 0,520 | 0,342 | 0,150 | 0,067 | 0,555 | 0,343 | 0,151 | 0,075 | 0,431 | 0,340 | 0,206 | 0,121 |
| **30** | | **2** | **Theo.** | **0,889** | **0,675** | **0,260** | **0,070** | **0,864** | **0,666** | **0,309** | **0,119** | **0,797** | **0,671** | **0,410** | **0,194** |
|  | |  | Obs. | 0,624 | 0,392 | 0,134 | 0,042 | 0,584 | 0,392 | 0,178 | 0,084 | 0,478 | 0,389 | 0,240 | 0,135 |
| **40** | | **0.5** | **Theo.** | **0,463** | **0,404** | **0,315** | **0,256** | **0,796** | **0,395** | **0,145** | **0,074** | **0,591** | **0,400** | **0,202** | **0,112** |
|  | |  | Obs. | 0,207 | 0,226 | 0,226 | 0,229 | 0,506 | 0,236 | 0,101 | 0,061 | 0,304 | 0,226 | 0,137 | 0,093 |
| **40** | | **1** | **Theo.** | **0,808** | **0,621** | **0,334** | **0,164** | **0,904** | **0,615** | **0,239** | **0,097** | **0,805** | **0,621** | **0,330** | **0,156** |
|  | |  | Obs. | 0,475 | 0,353 | 0,204 | 0,124 | 0,631 | 0,356 | 0,145 | 0,073 | 0,470 | 0,352 | 0,200 | 0,117 |
| **40** | | **1.5** | **Theo.** | **0,919** | **0,740** | **0,346** | **0,119** | **0,935** | **0,734** | **0,326** | **0,121** | **0,878** | **0,739** | **0,432** | **0,198** |
|  | |  | Obs. | 0,645 | 0,440 | 0,190 | 0,077 | 0,685 | 0,441 | 0,188 | 0,085 | 0,561 | 0,439 | 0,256 | 0,138 |
| **40** | | **2** | **Theo.** | **0,958** | **0,808** | **0,353** | **0,091** | **0,949** | **0,802** | **0,404** | **0,145** | **0,912** | **0,805** | **0,516** | **0,236** |
|  | |  | Obs. | 0,744 | 0,502 | 0,178 | 0,052 | 0,715 | 0,503 | 0,226 | 0,097 | 0,614 | 0,500 | 0,301 | 0,157 |
| **50** | | **0.5** | **Theo.** | **0,595** | **0,492** | **0,358** | **0,270** | **0,884** | **0,484** | **0,171** | **0,080** | **0,716** | **0,489** | **0,240** | **0,124** |
|  | |  | Obs. | 0,271 | 0,272 | 0,250 | 0,235 | 0,602 | 0,283 | 0,114 | 0,064 | 0,381 | 0,274 | 0,156 | 0,099 |
| **50** | | **1** | **Theo.** | **0,900** | **0,727** | **0,400** | **0,186** | **0,959** | **0,722** | **0,293** | **0,110** | **0,899** | **0,726** | **0,396** | **0,179** |
|  | |  | Obs. | 0,580 | 0,429 | 0,240 | 0,134 | 0,733 | 0,432 | 0,171 | 0,079 | 0,577 | 0,429 | 0,237 | 0,128 |
| **50** | | **1.5** | **Theo.** | **0,967** | **0,836** | **0,426** | **0,142** | **0,976** | **0,832** | **0,401** | **0,141** | **0,946** | **0,835** | **0,517** | **0,229** |
|  | |  | Obs. | 0,745 | 0,531 | 0,231 | 0,089 | 0,784 | 0,532 | 0,225 | 0,095 | 0,671 | 0,530 | 0,304 | 0,155 |
| **50** | | **2** | **Theo.** | **0,986** | **0,891** | **0,443** | **0,112** | **0,982** | **0,888** | **0,493** | **0,171** | **0,965** | **0,890** | **0,608** | **0,276** |
|  | |  | Obs. | 0,832 | 0,599 | 0,223 | 0,061 | 0,811 | 0,600 | 0,274 | 0,110 | 0,725 | 0,597 | 0,361 | 0,179 |
| **100** | | **0.5** | **Theo.** | **0,948** | **0,810** | **0,550** | **0,341** | **0,996** | **0,804** | **0,310** | **0,111** | **0,975** | **0,809** | **0,421** | **0,182** |
|  | |  | Obs. | 0,609 | 0,503 | 0,365 | 0,272 | 0,891 | 0,507 | 0,182 | 0,081 | 0,726 | 0,503 | 0,254 | 0,131 |
| **100** | | **1** | **Theo.** | **0,998** | **0,962** | **0,900** | **0,291** | **1,000** | **0,961** | **0,600** | **0,178** | **0,998** | **0,962** | **0,900** | **0,287** |
|  | |  | Obs. | 0,903 | 0,733 | 0,407 | 0,188 | 0,961 | 0,733 | 0,303 | 0,112 | 0,902 | 0,733 | 0,405 | 0,184 |
| **100** | | **1.5** | **Theo.** | **1,000** | **0,989** | **0,736** | **0,262** | **1,000** | **0,989** | **0,705** | **0,247** | **1,000** | **0,989** | **0,805** | **0,381** |
|  | |  | Obs. | 0,967 | 0,839 | 0,433 | 0,145 | 0,977 | 0,839 | 0,412 | 0,144 | 0,948 | 0,839 | 0,523 | 0,235 |
| **100** | | **2** | **Theo.** | **1,000** | **0,996** | **0,783** | **0,238** | **1,000** | **0,996** | **0,811** | **0,312** | **1,000** | **0,996** | **0,884** | **0,464** |
|  | |  | Obs. | 0,985 | 0,893 | 0,451 | 0,115 | 0,983 | 0,893 | 0,503 | 0,176 | 0,966 | 0,892 | 0,613 | 0,281 |

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1. These sample sizes were chosen because it will be shown later that depending on the distribution underlying the data, 50 or 100 subjects per group are needed in order that the type 1 error rate converge to the nominal 5%. [↑](#footnote-ref-1)
2. These sample sizes were chosen because it will be shown later that depending on the distribution underlying the data, 50 or 100 subjects per group are needed in order that the type 1 error rate converge to the nominal 5%. [↑](#footnote-ref-2)
3. Remember than one consider “sufficiently close” to the nominal alpha risk if its value falls in the interval [0.025; 0.075] (Hayes & Cai, 2007). [↑](#footnote-ref-3)
4. Note that the Type 1 error rate of the *W*-test is very close to Type 1 error rate of Jame’s test and Alexander-Govern test, meaning that they have very similar strengths and limitations. These two last tests are both available in R, but not in SPSS. [↑](#footnote-ref-4)
5. Note that it is not possible to compare results when k=2 and when k=3, because the sample size is not the same. [↑](#footnote-ref-5)