

1. *Topic Description and Objectives:*

- **CASE 1:** An Investigation Of The Level of Type I Error Of Student's Independent t For Mutually Independent Random Samples From Normal Distributions
- The student will be able to determine where the Student's Independent t test should be used in determining Type I error, in the case of two mutually independent groups having the following characteristics:
- *Equal variances and equal sample sizes.*

2. *MC2G Program Setup (verify the following input before running analysis):*

	Group 1	Group 2		Value
<b>Population Mean =</b>	0.0	0.0	<b>Number of Means to Keep =</b>	N/A
<b>Population SD =</b>	1.0	1.0	<b>Statistical Test =</b>	POOLED <i>t</i>
<b>Group Size =</b>	25	25	<b>Correlation bet. Measures =</b>	0
<b>Distribution =</b>	NORMAL	NORMAL	<b>Directionality of Hypothesis =</b>	TWO-TAILED
<b>Reliability =</b>	1.0	1.0	<b>Alpha Level =</b>	0.05
<b>Integer Data =</b>	UNCHECKED	UNCHECKED	<b>Automatically set...Seed... =</b>	UNCHECKED
<b>Minimum =</b>	N/A	N/A	<b>Integer Seed =</b>	19022410
<b>Maximum =</b>	N/A	N/A	<b>Number of MC Samples =</b>	10000

3. *Steps Necessary to Run Analysis:*

- Click **RUN** or press **F5** to run Monte Carlo analysis.
- Make sure the two groups have equal means. (In the case that the means are not equal, the matter in question becomes a power issue; if that is the case, please see the power section, which accompanies this paper.)

4. *MC2G Program Output (based on Input Above):*

<b># Rejections =</b>	501	<b>Actual Mean Grp 1 Means =</b>	0.0018
<b>Actual ALPHA / POWER =</b>	0.0510	<b>Actual Mean Grp 2 Means =</b>	0.0011
<b>Desired =</b>	0.05	<b>Actual SE of Grp 1 Means =</b>	0.2000
		<b>Actual SE of Grp 2 Means =</b>	0.1997

5. *Key Points to Interpret from the Monte Carlo Results:*

- Remember that there are two groups of equal variances and sample sizes.
- Find Actual alpha (proportion or Type I error), so it is .05.
- Remember that the nominal alpha (desired) was set at .05.
- Compare the two values in terms of the size.
- Given these conditions, actual alpha (0.05) is apparently okay because it is within 10% of nominal alpha (between 0.0450 and 0.0550).
- Decision is that the Student's Independent t (Pooled Variance) is robust because it controlled the probabilities of Type I error at the stated levels of significance alpha for the two-tailed tests.

1. *Topic Description and Objectives:*

- **CASE 2:** An Investigation Of The Level of Type I Error Of Student's Independent t For Mutually Independent Random Samples From Normal Distributions
- The student will be able to determine where the Student's Independent t test should be used in determining Type I error, in the case of two mutually independent groups having the following characteristics:
- *Equal variances but unequal sample sizes.*

2. *MC2G Program Setup (verify the following input before running analysis):*

	Group 1	Group 2		Value
<b>Population Mean =</b>	0.0	0.0	<b>Number of Means to Keep =</b>	N/A
<b>Population SD =</b>	1.0	1.0	<b>Statistical Test =</b>	POOLED <i>t</i>
<b>Group Size =</b>	25	50	<b>Correlation bet. Measures =</b>	0.0
<b>Distribution =</b>	NORMAL	NORMAL	<b>Directionality of Hypothesis =</b>	TWO-TAILED
<b>Reliability =</b>	1.0	1.0	<b>Alpha Level =</b>	0.05
<b>Integer Data =</b>	UNCHECKED	UNCHECKED	<b>Automatically set...Seed... =</b>	UNCHECKED
<b>Minimum =</b>	N/A	N/A	<b>Integer Seed =</b>	19022410
<b>Maximum =</b>	N/A	N/A	<b>Number of MC Samples =</b>	10000

3. *Steps Necessary to Run Analysis:*

- Click **RUN** or press **F5** to run Monte Carlo analysis.
- Make sure the two groups have equal means. (In the case that the means are not equal, the matter in question becomes a power issue; if that is the case, please see the power section, which accompanies this paper.)

4. *MC2G Program Output (based on Input Above):*

<b># Rejections =</b>	516	<b>Actual Mean Grp 1 Means =</b>	0.0011
<b>Actual ALPHA / POWER =</b>	0.05160	<b>Actual Mean Grp 2 Means =</b>	0.0020
<b>Desired =</b>	0.05	<b>Actual SE of Grp 1 Means =</b>	0.2015
		<b>Actual SE of Grp 2 Means =</b>	0.1430

5. *Key Points to Interpret from the Monte Carlo Results:*

- Remember that there are two groups of equal variances but unequal sample sizes.
- Find Actual alpha (proportion or Type I error), so it is .052.
- Remember that the nominal alpha (desired) was set at .05.
- Compare the two values in terms of the size of difference between them.
- Given these conditions, actual alpha (0.052) is apparently okay because it is within 10% of nominal alpha (between 0.0450 and 0.0550).
- Decision is that the Student's Independent t (Pooled Variance) is robust because it controlled the probabilities of Type I error at the stated levels of significance alpha for the two-tailed tests.

1. *Topic Description and Objectives:*

- **CASE 3:** An Investigation Of The Level of Type I Error Of Student's Independent t For Mutually Independent Random Samples From Normal Distributions
- The student will be able to determine where the Student's Independent t test should be used in determining Type I error, in the case of two mutually independent groups having the following characteristic:
- *Unequal variances but equal sample sizes.*

2. *MC2G Program Setup (verify the following input before running analysis):*

	Group 1	Group 2		Value
<b>Population Mean =</b>	0.0	0.0	<b>Number of Means to Keep =</b>	N/A
<b>Population SD =</b>	5.0	1.0	<b>Statistical Test =</b>	POOLED <i>t</i>
<b>Group Size =</b>	25	25	<b>Correlation bet. Measures =</b>	0
<b>Distribution =</b>	NORMAL	NORMAL	<b>Directionality of Hypothesis =</b>	TWO-TAILED
<b>Reliability =</b>	1.0	1.0	<b>Alpha Level =</b>	0.05
<b>Integer Data =</b>	UNCHECKED	UNCHECKED	<b>Automatically set...Seed... =</b>	UNCHECKED
<b>Minimum =</b>	N/A	N/A	<b>Integer Seed =</b>	19022410
<b>Maximum =</b>	N/A	N/A	<b>Number of MC Samples =</b>	10000

3. *Steps Necessary to Run Analysis:*

- Click **RUN** or press **F5** to run Monte Carlo analysis.
- Make sure that the two groups have equal means. (In the case that the means are not equal, the matter in question becomes a power issue; if that is the case, please see the power section, which accompanies this paper.)

4. *MC2G Program Output (based on Input Above):*

<b># Rejections =</b>	529	<b>Actual Mean Grp 1 Means =</b>	0.0092
<b>Actual ALPHA / POWER =</b>	0.05290	<b>Actual Mean Grp 2 Means =</b>	0.0011
<b>Desired =</b>	0.05	<b>Actual SE of Grp 1 Means =</b>	0.9998
		<b>Actual SE of Grp 2 Means =</b>	0.1997

5. *Key Points to Interpret from the Monte Carlo Results:*

- Remember that there are two groups of unequal variances but equal sample sizes.
- Find Actual alpha (proportion or Type I error), so it is .053.
- Remember that the nominal alpha (desired) was set at .05.
- Compare the two values in terms of the size of difference between them.
- Given these conditions, actual alpha (0.053) is apparently okay because it is within 10% of nominal alpha (between 0.0450 and 0.0550).
- Decision is that the Student's Independent t (Pooled Variance) is robust because it controlled the probabilities of Type I error at the stated levels of significance alpha for the two-tailed tests.

1. *Topic Description and Objectives:*

- **CASE 4:** An Investigation Of The Level of Type I Error Of Student's Independent t For Mutually Independent Random Samples From Normal Distributions
- The student will be able to determine where the Student's Independent t test should be used in determining Type I error, in the case of two mutually independent groups having the following characteristics:
- *Unequal variances and unequal sample sizes (with larger variability in the group with smaller sample size)*

2. *MC2G Program Setup (verify the following input before running analysis):*

	Group 1	Group 2		Value
<b>Population Mean =</b>	0.0	0.0	<b>Number of Means to Keep =</b>	N/A
<b>Population SD =</b>	5.0	1.0	<b>Statistical Test =</b>	POOLED <i>t</i>
<b>Group Size =</b>	25	50	<b>Correlation bet. Measures =</b>	0
<b>Distribution =</b>	NORMAL	NORMAL	<b>Directionality of Hypothesis =</b>	TWO-TAILED
<b>Reliability =</b>	1.0	1.0	<b>Alpha Level =</b>	0.05
<b>Integer Data =</b>	UNCHECKED	UNCHECKED	<b>Automatically set...Seed... =</b>	UNCHECKED
<b>Minimum =</b>	N/A	N/A	<b>Integer Seed =</b>	19022410
<b>Maximum =</b>	N/A	N/A	<b>Number of MC Samples =</b>	10000

3. *Steps Necessary to Run Analysis:*

- Click **RUN** or press **F5** to run Monte Carlo analysis.
- Make sure that the two groups have equal means. (In the case that the means are not equal, the matter in question becomes a power issue; if that is the case, please see the power section, which accompanies this paper.)
- Make sure that the larger variability is with the group of the smaller sample size.

4. *MC2G Program Output (based on Input Above):*

<b># Rejections =</b>	1629	<b>Actual Mean Grp 1 Means =</b>	0.0056
<b>Actual ALPHA / POWER =</b>	0.1629	<b>Actual Mean Grp 2 Means =</b>	0.0020
<b>Desired =</b>	0.05	<b>Actual SE of Grp 1 Means =</b>	1.0076
		<b>Actual SE of Grp 2 Means =</b>	0.1430

5. *Key Points to Interpret from the Monte Carlo Results:*

- Remember that there are two groups of unequal variances and unequal sample sizes (With larger variability in the group with the smaller sample size).
- Find Actual alpha (proportion or Type I error), so it is .163.
- Remember that the nominal alpha (desired) was set at .05.
- Compare the two values in terms of the size of difference between them.
- Given these conditions, actual alpha (0.163) is inflated. It is more than 10% greater than our nominal alpha (0.05).
- Decision is that the Student's Independent t (Pooled Variance) is more liberal because it did not control the probabilities of Type I error at the stated levels of significance alpha for the two-tailed tests.

1. *Topic Description and Objectives:*

- **CASE 5:** An Investigation Of The Level of Type I Error Of Student's Independent t For Mutually Independent Random Samples From Normal Distributions
- The student will be able to determine where the Student's Independent t test should be used in determining Type I error, in the case of two mutually independent groups having the following characteristics:
- *Unequal variances and unequal sample sizes (with larger variability in the group with larger sample size)*

2. *MC2G Program Setup (verify the following input before running analysis):*

	Group 1	Group 2		Value
<b>Population Mean =</b>	0.0	0.0	<b>Number of Means to Keep =</b>	N/A
<b>Population SD =</b>	5.0	1.0	<b>Statistical Test =</b>	POOLED <i>t</i>
<b>Group Size =</b>	50	25	<b>Correlation bet. Measures =</b>	0
<b>Distribution =</b>	NORMAL	NORMAL	<b>Directionality of Hypothesis =</b>	TWO-TAILED
<b>Reliability =</b>	1.0	1.0	<b>Alpha Level =</b>	0.05
<b>Integer Data =</b>	UNCHECKED	UNCHECKED	<b>Automatically set...Seed... =</b>	UNCHECKED
<b>Minimum =</b>	N/A	N/A	<b>Integer Seed =</b>	19022410
<b>Maximum =</b>	N/A	N/A	<b>Number of MC Samples =</b>	10000

3. *Steps Necessary to Run Analysis:*

- Click **RUN** or press **F5** to run Monte Carlo analysis.
- Make sure that the two groups have equal means. In the case that the means are not equal, the matter in question becomes a power issue. If that is the case, please see the power section, which accompanies this paper.
- Make sure that the larger variability is with the group of the larger sample size.

4. *MC2G Program Output (based on Input Above):*

<b># Rejections =</b>	95	<b>Actual Mean Grp 1 Means =</b>	0.0090
<b>Actual ALPHA / POWER =</b>	0.0095	<b>Actual Mean Grp 2 Means =</b>	0.0044
<b>Desired =</b>	0.05	<b>Actual SE of Grp 1 Means =</b>	0.7037
		<b>Actual SE of Grp 2 Means =</b>	0.2004

5. *Key Points to Interpret from the Monte Carlo Results:*

- Remember that there are two groups of unequal variances and unequal sample sizes (With larger variability in the group with the larger sample size).
- Find Actual alpha (proportion or Type I error), so it is .001.
- Remember that the nominal alpha (desired) was set at .05.
- Compare the two values in terms of the size of difference between them.
- Given these conditions, actual alpha (0.001) is conservative. It is more than 10% less than our nominal alpha (0.05).
- Decision is that the Student's Independent t (Pooled Variance) is more conservative because it did not control the probabilities of Type I error at the stated levels of significance alpha for the two-tailed tests.