

Randomized Evaluation using Parametric Bootstrap to study the differences in Income & Expenses, between Households with & without Microcredit (from Chandpur)

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This document outlines the analysis performed to study the differences in Income & Expenses of Households that have taken Microcredit (Intervention), and Households that have not (Control).

There were a total of 28 Households that were studied; 13 categorized into the Control Group and 15 into the Intervention Group.

This part of the analysis was purposed to identify whether there exists any statistically significant difference(s) between the Income/Expenses of the 2 Groups.

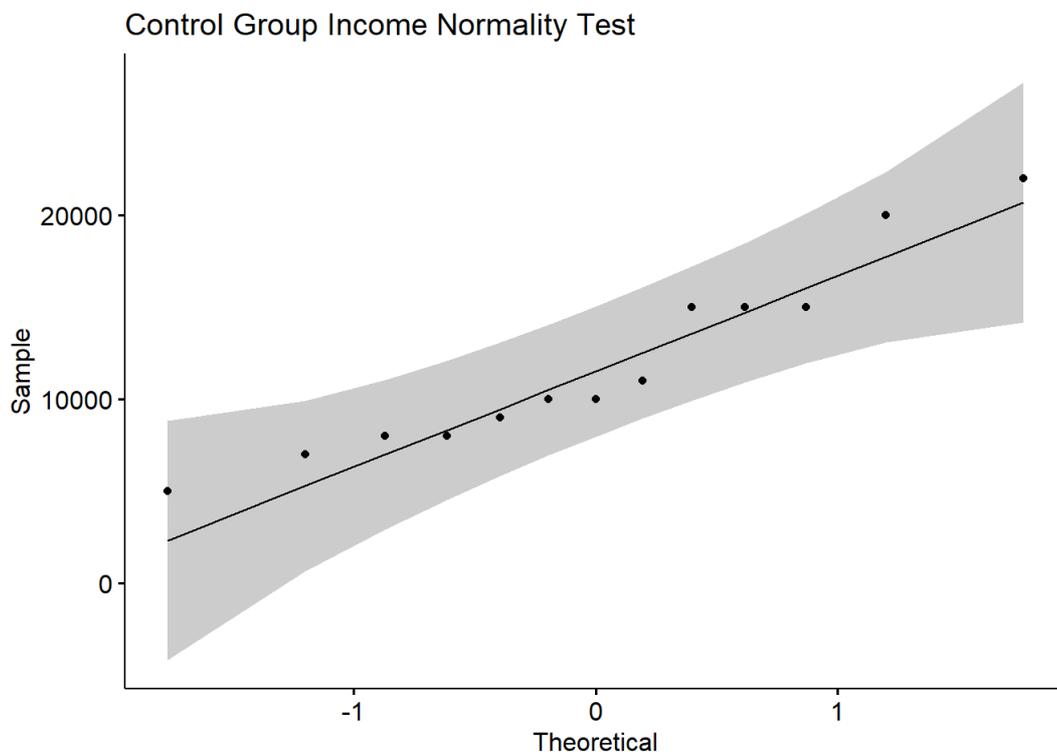
The following Hypothesis Tests were conducted:

1. H0: There exists no statistically significant differences in the Mean Incomes of the Control & Intervention Groups at the sample-level at 95% CI; H1: Otherwise
2. H0: There exists no statistically significant differences in the Mean Incomes of the Control & Intervention Groups at the population-level at 95% CI; H1: Otherwise
3. H0: There exists no statistically significant differences in the Mean Expenses of the Control & Intervention Groups at the sample-level at 95% CI; H1: Otherwise
4. H0: There exists no statistically significant differences in the Mean Expenses of the Control & Intervention Groups at the population-level at 95% CI; H1: Otherwise

To estimate parameters at population levels, **Parametric Bootstrap Simulations** were performed, simulating the sample size parameter estimates to their population level estimates.

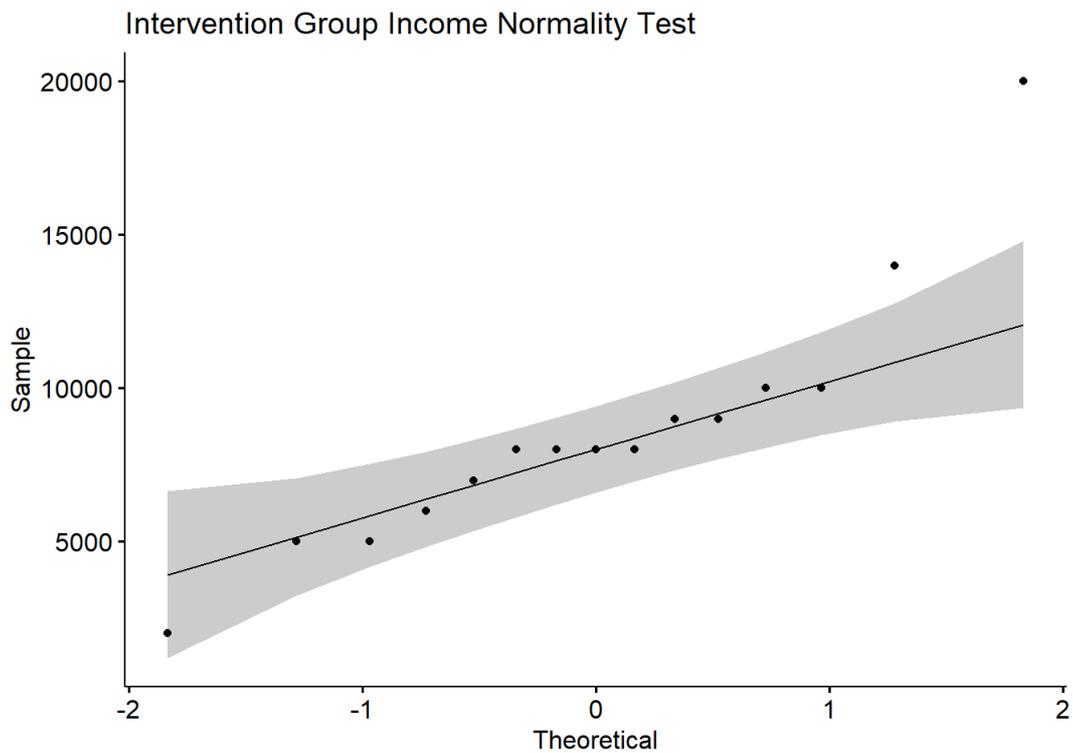
PART A: Household Income Analysis of Intervention/Control Group

Test: Check Normality of the Control Group's Income



```
##  
## Shapiro-Wilk normality test  
##  
## data: Control$Monthly_Income  
## W = 0.92093, p-value = 0.2582
```

Test: Check Normality of the Intervention Group's Income

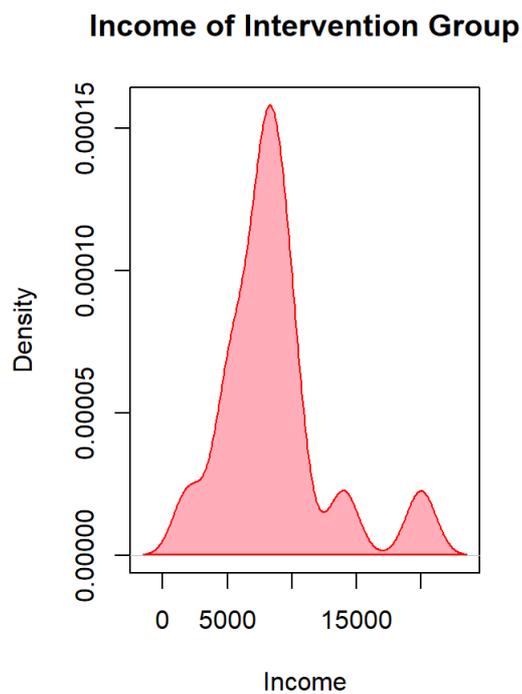
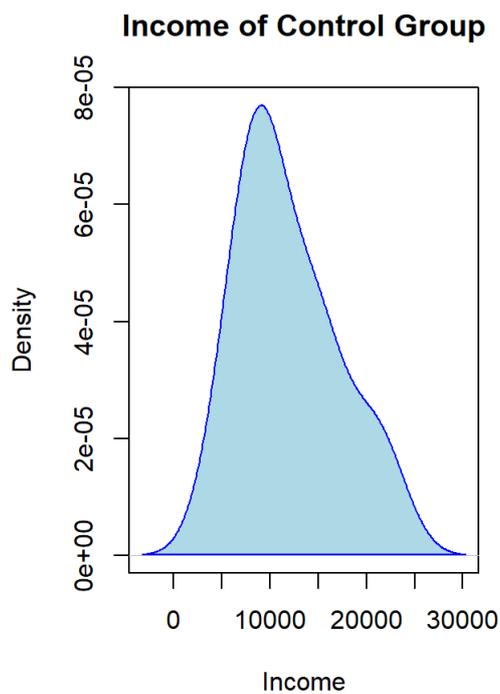


```
##  
## Shapiro-Wilk normality test  
##  
## data: Intervention$Monthly_Income  
## W = 0.87542, p-value = 0.04056
```

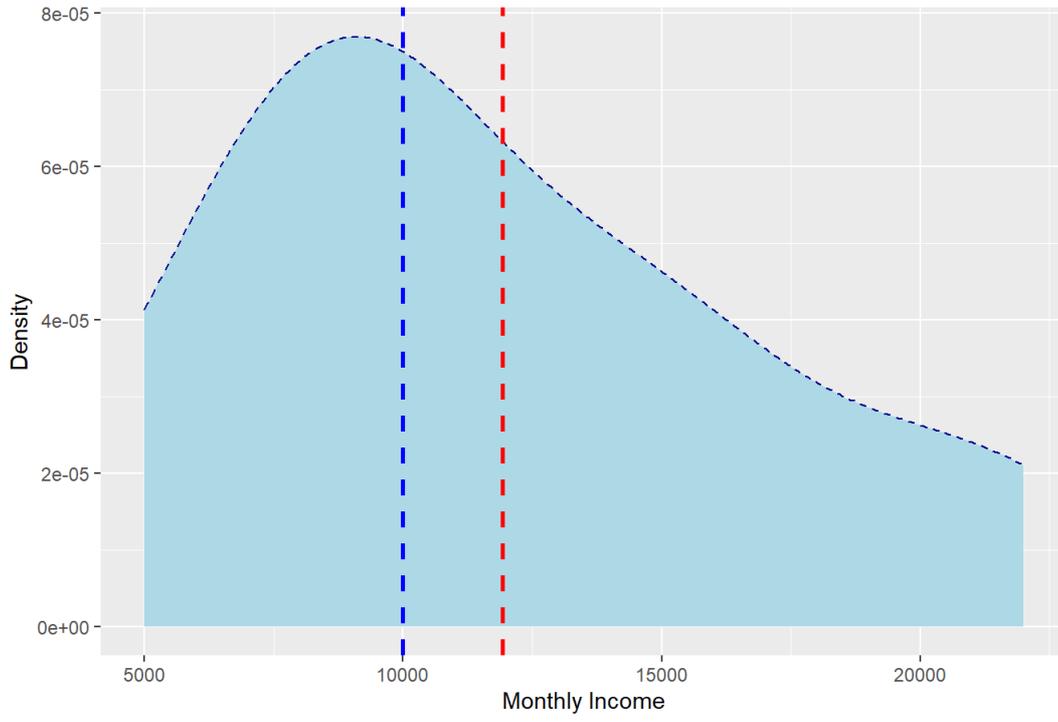
Both the Control and Intervention Groups' Income Distributions look approximately Normal. Hence we can apply Parametric Bootstrap.

PART B: Comparing Distributions

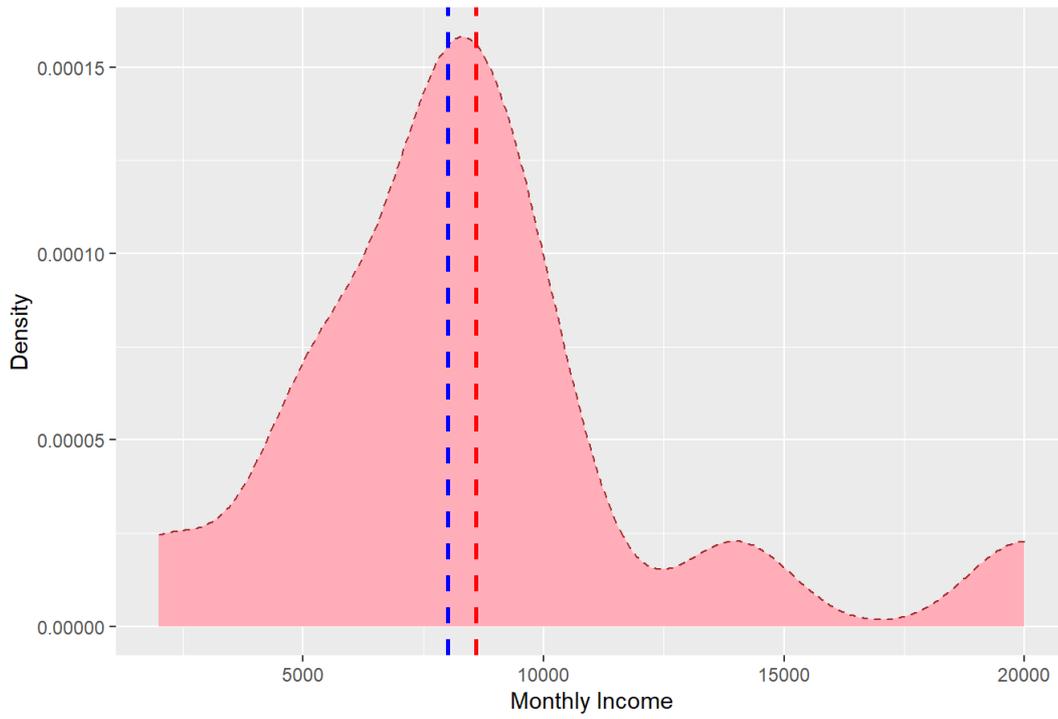
Plot the Income Distributions of the Control and Intervention Groups (sample):



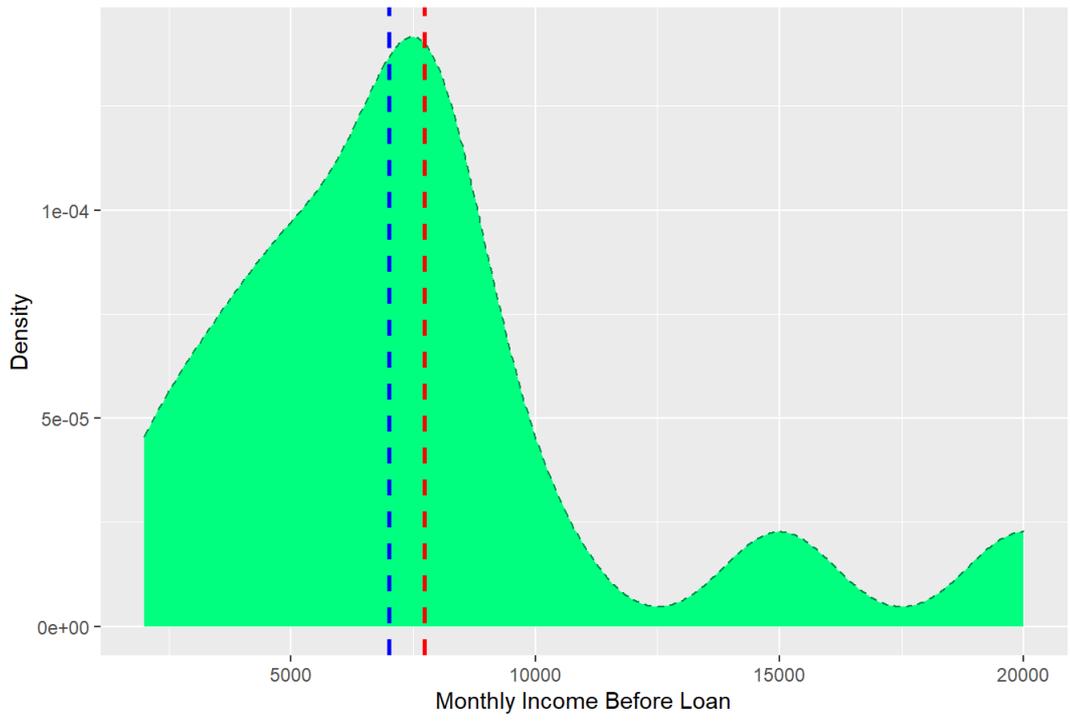
Control Group Income Distribution (Red = Mean, Blue = Median)



Intervention Group Income Distribution (Red = Mean, Blue = Median)

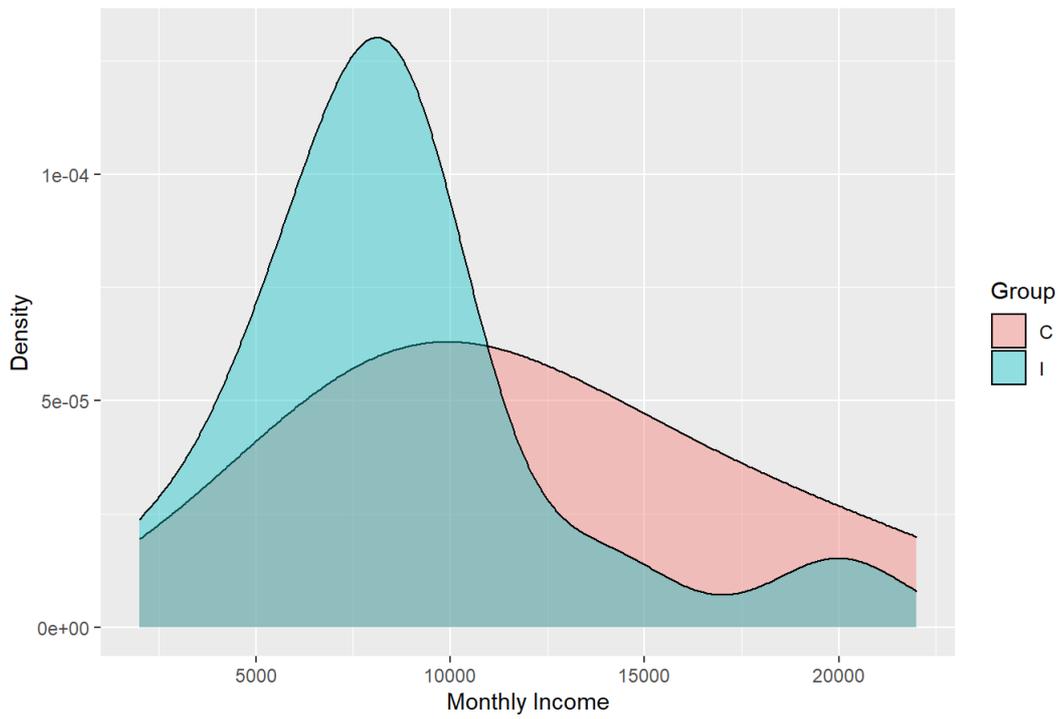


Intervention Group Income Distribution Pre-Microfinance (Red = Mean, Blue = M)



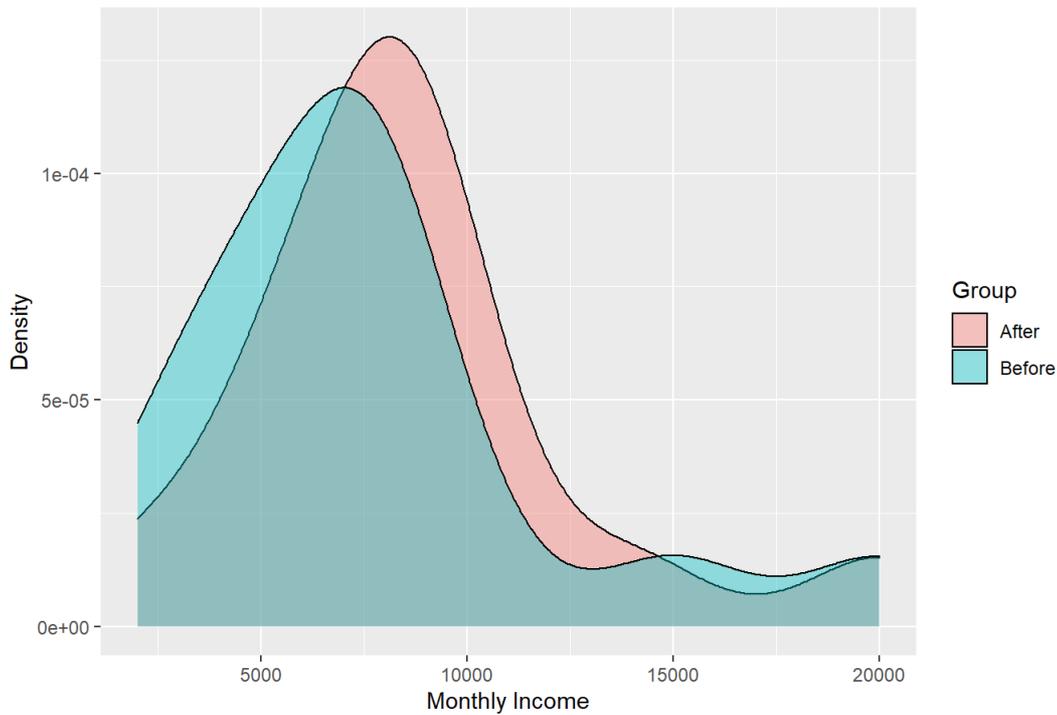
Compare the Distributions of the 2 Groups (Control-Intervention):

Density Plots of Incomes of Control & Intervention Groups



Compare the Distributions of the Intervention Group, pre and post Microcredit:

Density Plots of Households Before & After Microfinance



PART C: Hypothesis Tests

Test 1: H0: There exists no statistically significant difference in the Mean Incomes of the Control & Intervention Groups at the sample-level at 95% CI

```
##  
## Welch Two Sample t-test  
##  
## data: Intervention$Monthly_Income and Control$Monthly_Income  
## t = -1.8639, df = 23.19, p-value = 0.07505  
## alternative hypothesis: true difference in means is not equal to 0  
## 95 percent confidence interval:  
## -7009.6190 363.4652  
## sample estimates:  
## mean of x mean of y  
## 8600.00 11923.08
```

Results: $p = 0.075$. As $p > 0.05$, we fail to reject the Null Hypothesis, H0 that the two sample means (Mean of Control Income, Mean of Intervention Income) are statistically equal at 95% Confidence Interval.

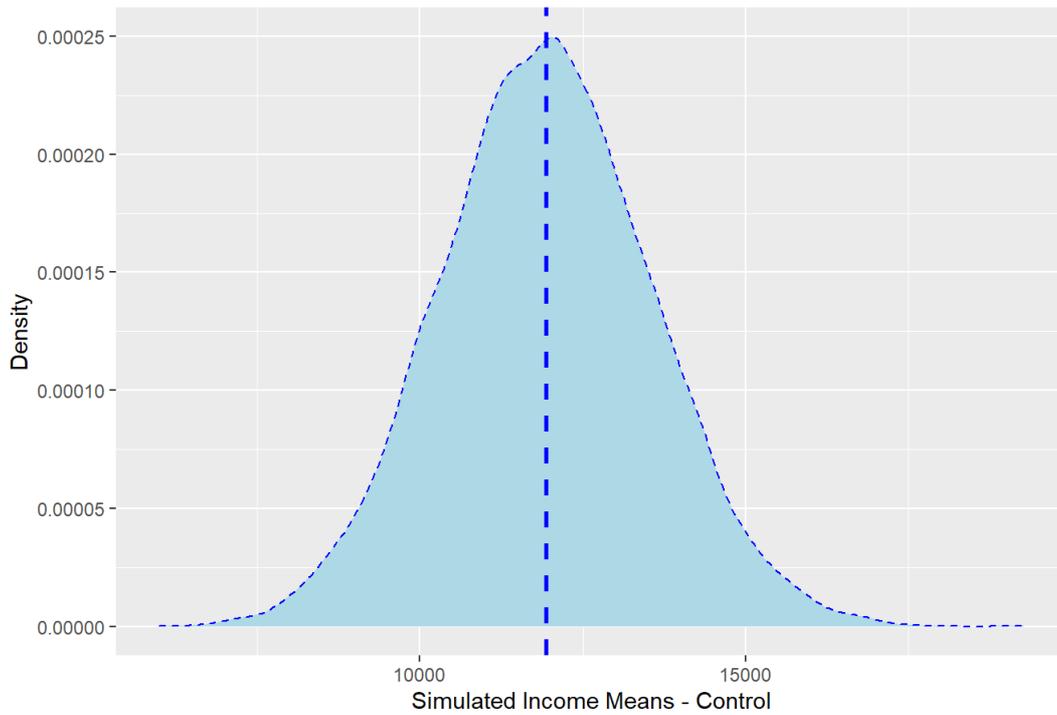
Perform Parametric Bootstrap Simulation:

-> Set the number of simulations: $k = 10000$.

Results: Data Normally Distributed for both ~ therefore apply Normal Parametric Bootstrap Sampling

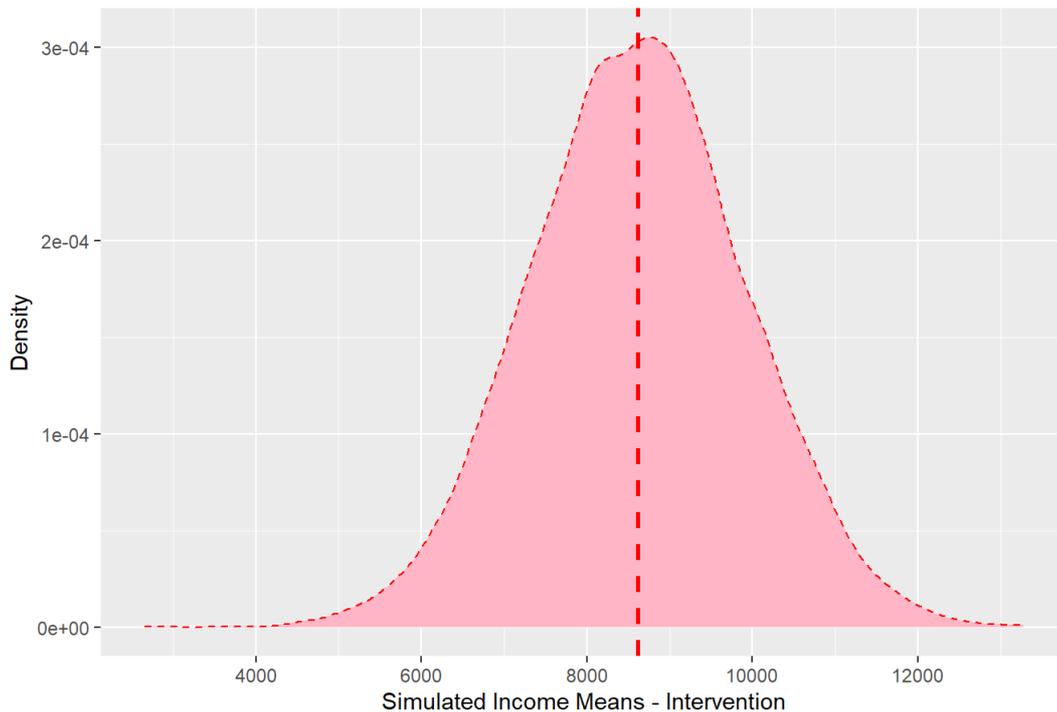
```
## [1] 11938.09
```

Density Plot of Simulated Income Means - Control



```
## [1] 8613.383
```

Density Plot of Simulated Income Means - Intervention



Test 2: H0: There exists no statistically significant differences in the Mean Incomes of the Control & Intervention Groups at the population-level at 95% CI

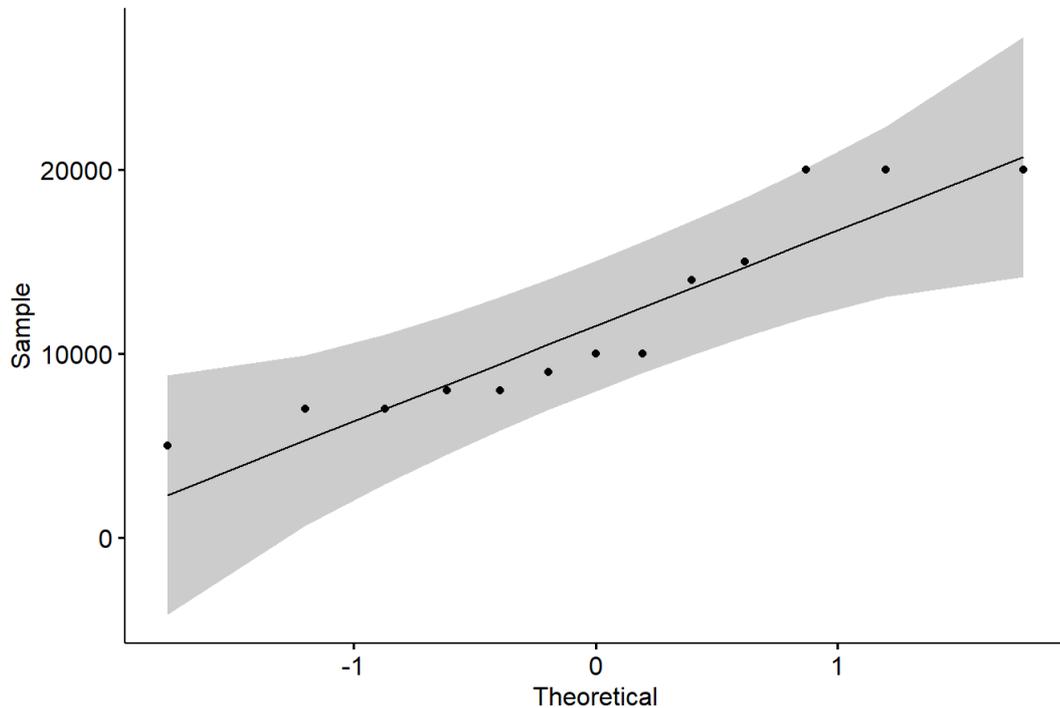
```
##  
## Welch Two Sample t-test  
##  
## data: sim_control_means and sim_intervention_means  
## t = 160.45, df = 19141, p-value < 2.2e-16  
## alternative hypothesis: true difference in means is not equal to 0  
## 95 percent confidence interval:  
## 3284.088 3365.318  
## sample estimates:  
## mean of x mean of y  
## 11938.086 8613.383
```

Results: p-value < 2.2e-16. As $p < 0.05$, we reject the Null Hypothesis, H_0 : the two means (Mean Control Income, Mean Intervention Income) in favor of the Alternative Hypothesis, H_1 : the two means are NOT equal, at the 95% Confidence Interval.

PART D: Household Expenses Analysis of Control/Intervention Groups

Test: Check for Normality of Household Expenses of the Control Group:

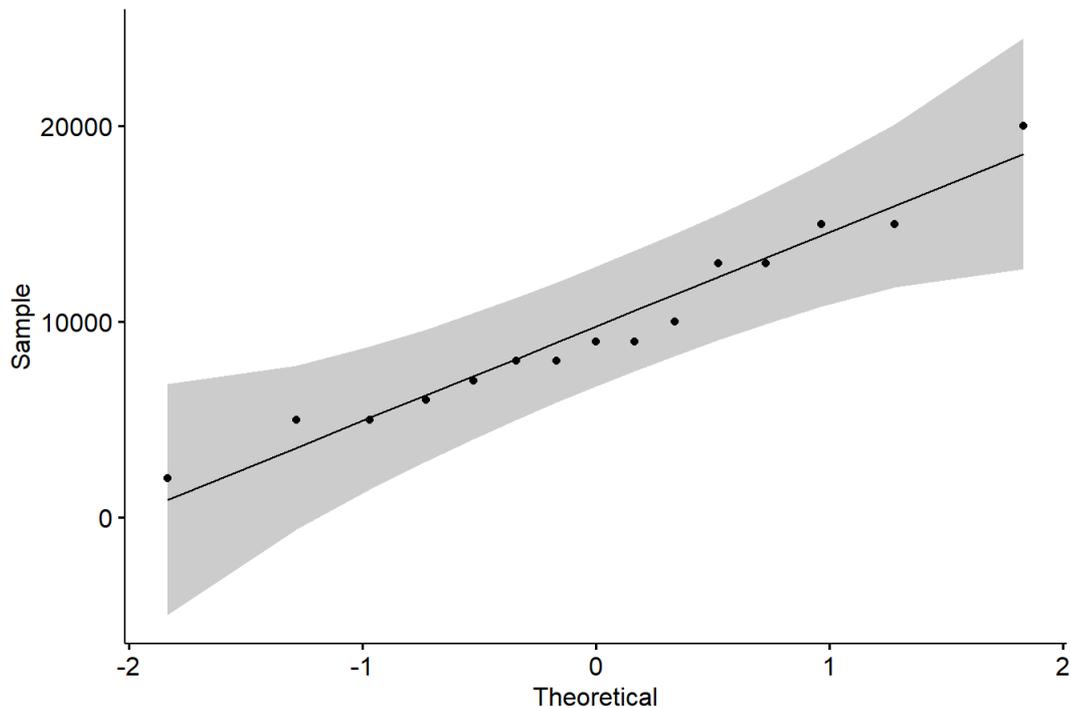
Control Group Household Expenses Normality Test



```
##  
## Shapiro-Wilk normality test  
##  
## data: Control$Household_Expenses  
## W = 0.85971, p-value = 0.03819
```

Test: Check for Normality of Household Expenses of the Intervention Group:

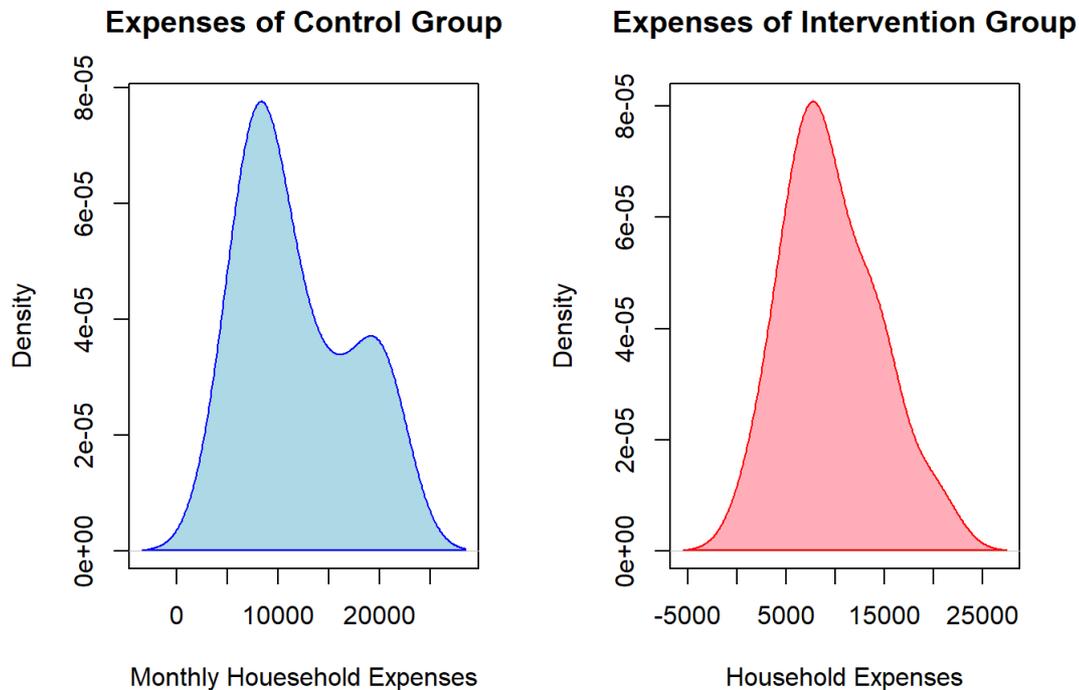
Intervention Group Household Expenses Normality Test



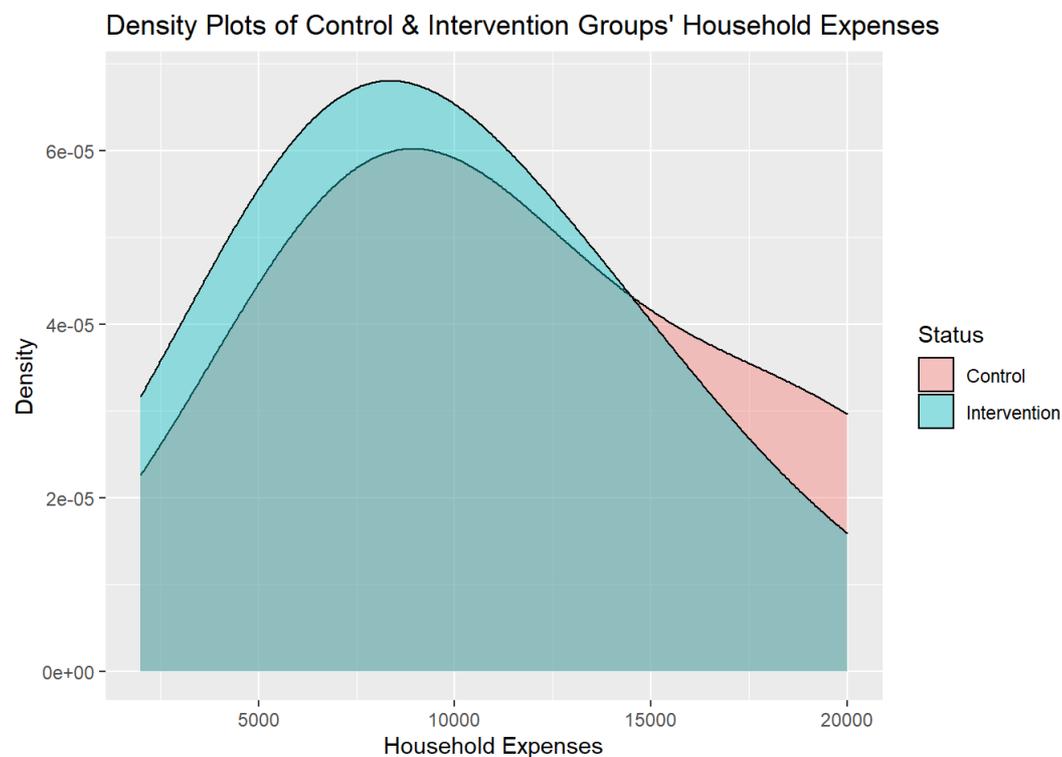
```
##
## Shapiro-Wilk normality test
##
## data: Intervention$Household_Expenses
## W = 0.96191, p-value = 0.7256
```

As data is Normal in both cases, we can perform Parametric Bootstrap.

Plot Distributions of Household Incomes for both the Control & Intervention Groups:



Plot Distributions of Household Incomes for both the Control & Intervention Groups:



PART E: Hypothesis Tests

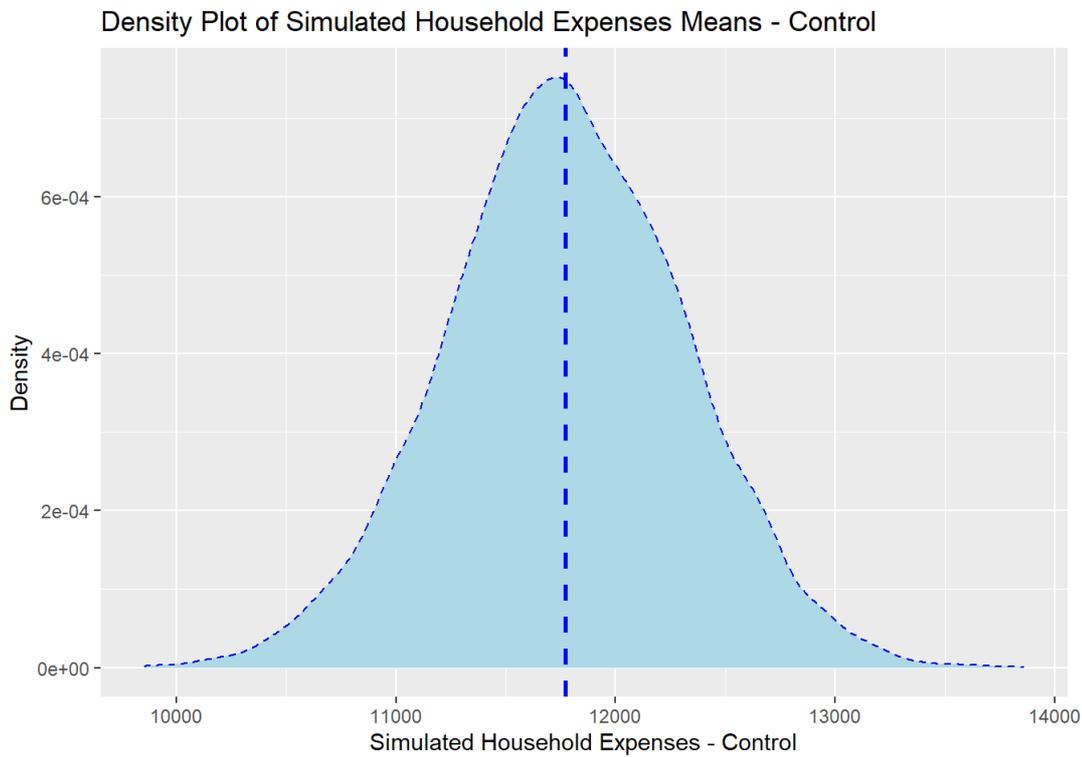
Test 3: H0: There exists no statistically significant differences in the Mean Incomes of the Control & Intervention Groups at the population-level at 95% CI

```
##  
## Welch Two Sample t-test  
##  
## data: Intervention$Household_Expenses and Control$Household_Expenses  
## t = -1.0843, df = 24.122, p-value = 0.2889  
## alternative hypothesis: true difference in means is not equal to 0  
## 95 percent confidence interval:  
## -6103.525 1898.397  
## sample estimates:  
## mean of x mean of y  
## 9666.667 11769.231
```

Results: $p = 0.2889$. As $p > 0.05$, we conclude that there does not exist sufficient evidence against H_0 and that there is no statistically significant differences between the Monthly Household Expenses of the Control and the Intervention Groups.

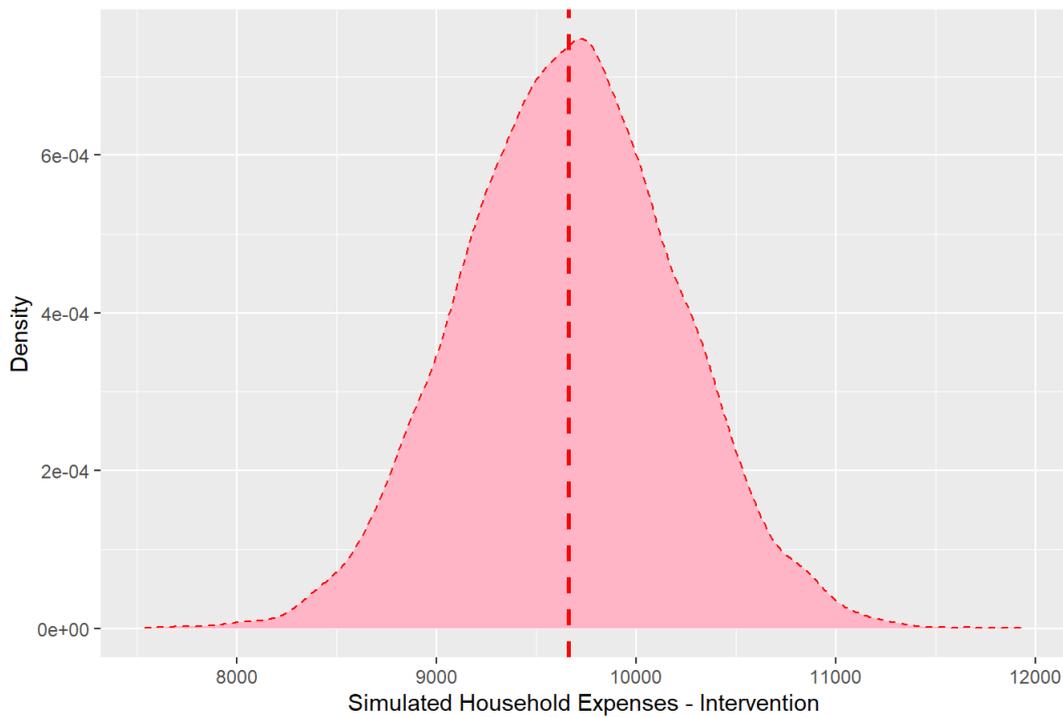
Parametric Bootstrap Simulation of Household Expenses (Control/Intervention):

```
## [1] 11771.63
```



```
## [1] 9660.081
```

Density Plot of Simulated Household Expenses Means - Intervention



Test 4: H0: There exists no statistically significant differences in the Mean Incomes of the Control & Intervention Groups at the population-level at 95% CI

```
##
## Welch Two Sample t-test
##
## data: exp_int_mean and exp_control_mean
## t = -276.66, df = 19995, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
## -2126.507 -2096.587
## sample estimates:
## mean of x mean of y
## 9660.081 11771.628
```

Results: $p < 2.2e-16$. As $p < 0.05$, we conclude that there exists sufficiently strong evidence against H0, and there does exist statistically significant differences between Household Expenses of the Control & the Intervention Groups.

Conclusion:

The above results show that although there exists no significant differences in the Income/Expenses between Households that have taken Microcredit and those that have not at the Sample-levels, there exists significant differences in the Income/Expenses between the 2 Groups at the Population-levels.

1. The large positive t-score attained from comparing the Bootstrapped Sample Mean of the Control Group's Average Income with that of the Intervention Group's suggests that the former has a Higher Mean compared to the latter.
2. The large negative t-score attained from comparing the Bootstrapped Sample Mean of the Intervention Group's Average Household Expenses with that of the Control Group's suggests that the former has a much Lower Mean compared to the latter.

In other words, while there exists no strong causality between Microcredit and instigation of entrepreneurial ventures, the effects of Microcredit are negligible in terms of increasing Household Income (post Microcredit scheme) and reducing poverty.

Microcredit schemes are found to be more popular with Households in the lower-income strata, however as the effects of Microcredit on the average Income are negligible (as can be seen by Comparing the Income Distributions of Households, pre and post Microcredit), there does not exist sufficient evidence to suggest Microfinance has been of benefit to the Households evaluated in this study.

Further research will be conducted to find consistencies with this study.