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A CASE STUDY BASED ON SINGULAR MEDIATION AND REGRESSION MODELS

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Abstract:
The research aims to study the impact of the Corona virus on the income and psychological state of individuals, as single mediation models were applied with regression models to study and show the effect of the variables under study. The distribution of the various classes came due to its importance to show the size of the impact on the largest possible number of segments of society, and after collecting the questionnaire and tabulating the data, the data was analyzed using the statistical program (R Program) and the results showed a significant and clear impact of the Corona virus on income, especially among the working classes. And with limited income, as well as on the psychological state.

Keywords: Singular mediation model , regression models, Covid 19, psychological state

INTRODUCTION

With the spread of the new Corona virus, COVID19, and observing its impact on society, as it threatens people's lives with almost a lack of infection methods and the necessary vaccine to reduce or eliminate it, for this reason, institutions have started working remotely using modern electronic methods, and this does not mean that all work can be accomplished electronically because many There are companies and laboratories that need to work in a present and field manner, as many of them have reduced the number of their employees or stopped and closed them completely due to the spread of the virus. In addition, the government started working to reduce movement by imposing a curfew, whether partial or total, to reduce the spread of the virus. Of the segments, especially those with low incomes and daily employers, so the study focused in this research on the impact of the Corona virus on the income of a number of segments and at the same time the effect of income on the psychological state.

Single Mediation Model (SMM)

The singular mediation model is considered the simplest mediation model as it consists of three variables (the independent variable X, the dependent variable Y, and the mediation variable M). This model is used when there is an influence of the independent variable on the mediation variable, which leads to an effect on the outcome variable and it is called the indirect relationship. This model has been applied Which is also called individual mediation or simple mediation in many fields, including social, educational, and behavioral sciences for the researcher's interest in learning about side effects that have not been studied (Wen 2013).

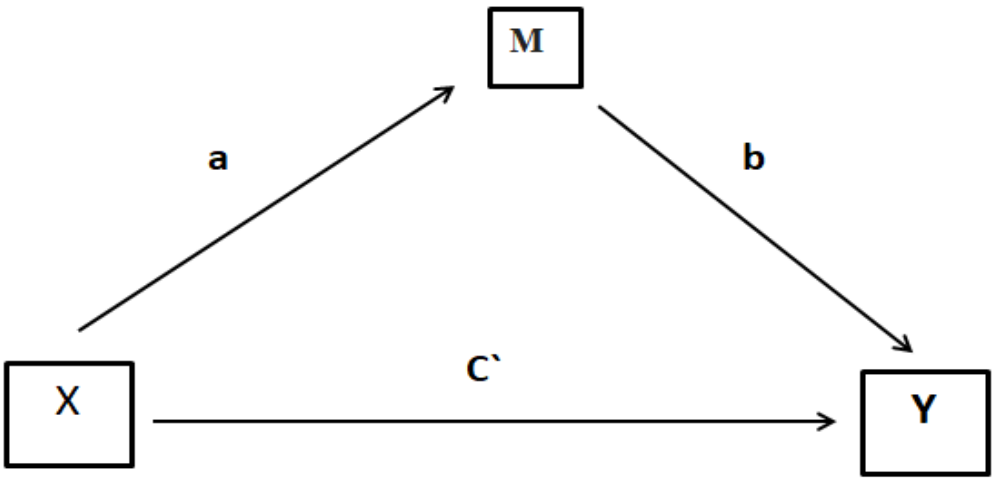
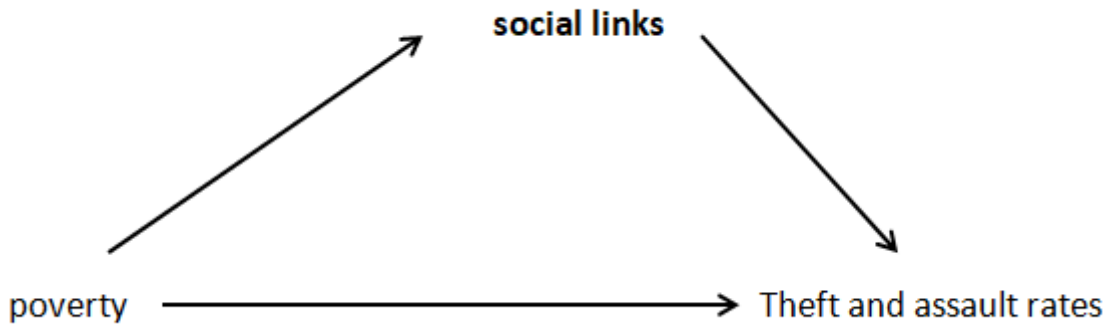


Figure (1): Represents the indirect effect of the independent variable on the dependent variable by the mediating variable.

The above figure shows the simplest mediation models as it represents a model for one mediating variable, the first variable being the independent variable (X), the second variable being the mediation variable (M), and the third variable being the dependent variable (Y). , there is a direct and indirect relationship where the arrow represents between the independent variable (X) and the dependent variable (Y) to the existence of a direct relationship between the independent variable X and the outcome variable Y (X → Y) and the second effect, which is the indirect result of the influence of the independent variable X on The mediation variable M, which in turn affects the outcome variable.

The symbols (a,b,c`) have indices where the symbol (a) represents the effect of the independent variable X on the mediating variable M, and also the symbol (b) represents the effect of the mediating variable M on the outcome of the variable Y, and the symbol C` on the overall effect of the variable The independent X on the outcome variable. (Rose, Chassin, Presson, & Sherman, 2000) (Imai, Keele, & Tingley, 2010).

Warner & Rountree (1997) studied the singular mediation model in the social sciences, where the relationship was as follows:



The following regression equations are used with the singular mediation model

$$M = Y_1 + ax + e_1 \quad \text{..... (1)}$$

$$Y = Y_2 + Cx + e_2 \quad \text{..... (2)}$$

$$Y = Y_3 + C`x + bM + e_3 \quad \text{..... (3)}$$

where

C: refers to the direct effect between the independent and dependent variable, and it is called the total effect.

C`: represents the indirect effect via the mediating variable M.

a: This parameter conveys the effect of the independent variable on the mediator variable.

b: This parameter transfers the effect of the mediator variable on the dependent variable.

M: represents the mediation variable.

X is the independent variable

Y: represents the dependent variable

From the above equations we note equation 1 represents the overall effect model, while equations 2 and 3 define the mediation model. (D. P. MacKinnon & Pirlott, 2015) (Otter, Pachali, Mayer, & Landwehr, 2018) (Tofighi & Thoemmes, 2014).

EFFECT OF MEDIATION

One of the most important reasons that motivates the researcher to study as well as know the process of influences that occur between the three variables (X, Y, M) is to clarify the causal process in which the independent variable affects the dependent variable (James & Brett, 1984).

The relationship between the two variables is divided X, Y in the case of two paths of mediation variable, the first path is the direct effect in which the independent variable X affects the dependent variable (X → Y), and the second path is the result of the influence of the independent variable X on the variable Y by the mediation variable M, which The indirect effect is called (X → M → Y).

The mediation effect is the amount of difference between the parameters of C-C`, the total effect is divided into a direct effect represented by the parameter C, and another indirect effect represented by the parameters (a, b). Samples used in regression equations, in such matters the estimate of C-C` may not be equal to the estimate of ab parameters. The parameters in the above three equations can be estimated using the Ordinary Least Squares (OLS) regression method or the Maximum Likelihood Estimation (MLE) method. After estimating the parameters, we can get an estimate of the direct and indirect effects. (D. P. MacKinnon, Krull, & Lockwood, 2000) (Bareinboim & Pearl, 2012)

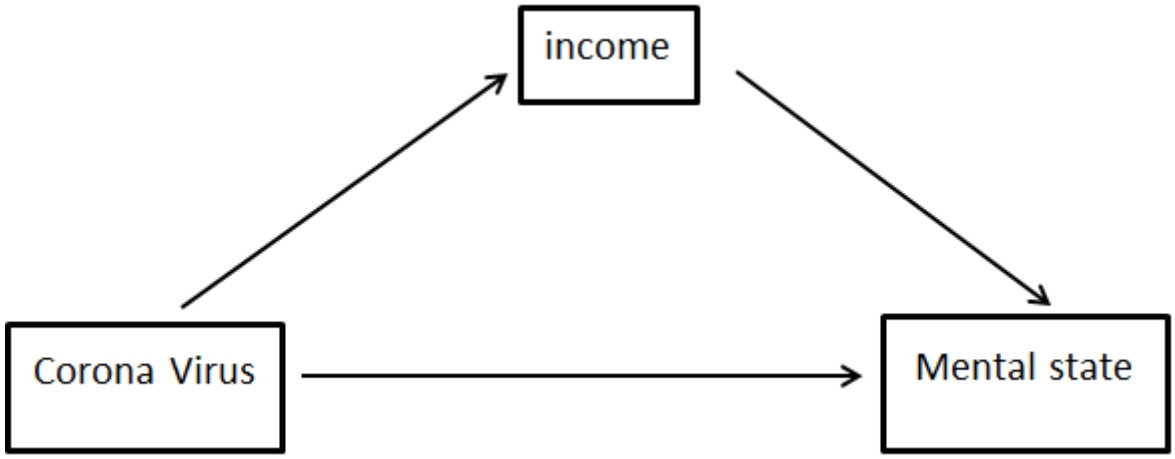
Steps of Mediation Analysis for Single Mediation Model

There is a set of steps developed by each of (Baron & Kenny, 1986) (James & Brett, 1984) (Judd & Kenny, 1981)

For mediation analysis:
1 - There must be a relationship between the independent variable and the dependent variable by parameter C.
2 - It is assumed that there is a relationship and an effect of the independent variable (X) on the mediating variable (M) by parameter a.
3 - There must be an effect of the mediating variable (M) on the dependent variable (Y) by parameter b.
4 - To prove that the variable (M) mediates both the independent variable (X) and the dependent variable (Y), the effect of X on Y for the parameter C` must be absolutely insignificant.

When the four steps are fully implemented, we can say that the data is consistent with the hypothesis that the variable M represents the mean of the independent variable X and the dependent variable Y completely, but in the case of failure to meet the fourth step, in this case it can be said that there is a mediation called partial mediation.

In this model, data on the impact of the Corona virus on psychological state by income were used, where data were collected by means of a questionnaire distributed to a number of different categories to ensure the greatest comprehensiveness of many segments.



Bootstrapping

In many studies, the sample size is not sufficient for the study, and this case is considered one of the problems facing researchers in many studies. To overcome such problems, Bolger & Shrout introduced in 2002, using the Bootstrapping method.
The delta method for estimating the standard error does not work well when the sample size is not large enough This limitation leads to the use of the Bootstrapping method.

Bootstrapping can be used to find the standard errors of the estimated parameter when the sampling distribution of the estimated parameter is unknown, and also Bootstrapping can be used to evaluate the accuracy of the estimated model and to evaluate the prediction accuracy (Wen, 2013).

The Bootstrapping method is one of the popular methods for estimating mediation parameters. Bootstrapping is based on restructuring with replacement a large number of times. That is, if we have a sample of size n, smoothing is performed by taking K of samples with iteration and substitution from the original sample size and preferably K = 1000 at least (Mascha, Dalton, Kurz, & Saager, 2013).

Each sample has its own characteristics, such as the median as well as an estimate of mediating effects for each sample. This method is used to make sample distributions as a basis for confidence intervals and to test hypotheses (D. MacKinnon, 2012).

parameter coefficients test

It is a method used to test the significance of the mediation effect using the product and the standard error of the product, the standard error derived from Sobel's equation was used in 1982 using the delta method based on the first-order Tyler series approximation (Sobel, 1982).

$$S_{ab} = \sqrt{S_a^2\, b^2 + S_b^2\, a^2}$$

The standard errors which depend on the computation are called the mediation effect ab product of the standard errors of the coefficients, and those which depend on C-C` are called the difference in the standard errors of the coefficients where C-C` is the standard error of the difference between the regression coefficients which can be calculated as:

$$S_{c-c`} = \sqrt{S_c^2 + S_{c`}^2 - 2\, r\, S_c\, S_{c`}}$$

After estimating standard errors, the upper and lower confidence limits for the influence of the mediator variable can be as follows

Upper confidence limit = mediated effect + **Z** ($\mathbf{S_{ab}}$)
Lower confidence limit = mediated effect - **Z** ($\mathbf{S_{ab}}$)

Standard error effects can be divided and compared with the Z distribution, for example, 1.96 and with a 95% confidence limit for a large sample size, and have an effect estimate of ab = c - c` of a type I error following the Z statistic (D. P. MacKinnon & Luecken, 2011) What is reported is Confidence limits for the effect of the symmetric mediator. As for the asymmetric confidence limits, it is more accurate because the effect of a normal distribution of the median is not required, it may be another distribution. Asymmetric confidence limits can be calculated by resampling or using critical values of the product distribution (D. MacKinnon, 2012).

income concept

Income is the return that the owner of the productive element deserves in return for his contribution to the production process. The worker gets the wages, whether his work is manual or mental. As for the land, the owner gets the rent or the rent, and the capital gets the interest

As for income in terms of the economic concept in Islamic theory, the owner of the capital either gets a share of the profit if the capital is cash, or he gets rent or a share of the profit if the capital is in kind, and the organization gets the profit.

Income can be defined as the service or benefit resulting from capital or labor. It has two sources: the first source is what a person owns of money, and the second source of income is what a person makes of work or economic activity. The first is called unearned income (Unearned income), While the second is known as earned income (Earned income).

Factors Affecting Income

The researcher believes that they are classified into controlled factors and uncontrolled factors, i.e. natural factors and unnatural factors natural or controlled factors that occur within the economic phenomena that can be measured and controlled and find solutions based on the foundations and methods previously used, such as inflation, unemployment, and the high or low cost of capital.

Unnatural or uncontrolled factors that occur without prior notice and have a greater impact than natural factors because they generally affect and are difficult to control quickly, such as floods, earthquakes, volcanoes, hurricanes, diseases, epidemics and the spread of insects and pests. The first type, in terms of the impact on the individual's income and the methods of treatment, requires more time, contributions and various plans than the first type. (Economic Dictionary-1977-145)

Data analysis results

First: We check the strength between corona effect (X), income effect (M) and psychological state (Y) by tracing the relationship path using the correlation matrix as shown in the table below:

	M	X	Y
M	1	0.42	0.36
X	0.42	1	0.35
Y	0.36	0.150	1

Table (1): The correlation matrix between the study variables.

The correlation matrix above Table (1) There is a correlation between the first variable (coronavirus) and the second variable (the amount of income) by (0.42), as well as the existence of a correlation between the first variable and the third variable (mental state) by (0.35), and there is also a relationship Correlation between the second variable and the third variable by (0.36).

In order to obtain the estimates of the parameters, the regression equation was used

$$Y = Y1 + CX + e1 \ldots\ldots\ldots (1)$$

Parameters	$\hat{C}$
Estimate	2.3305
Std. Error	0.1016
T value	22.95
Pr(>|t|)	<2e-16

Residual standard error	55.13
Multiple R-squared	0.9495
Adjusted R-squared	0.9477
F-statistic	526.6
p-value	< 2.2e-16

Table (2): The overall effect of the relationship between the variables.

We note from Table No. 2 that the estimate of the total effect (the direct effect) on the psychological state was (2.33) and the standard error was (0.101), and there was a significant effect of $p < 0.05$.

Also, the total error of the model was calculated by (55.13) and the coefficient of determination was by (0.94), while the significance of the model in general is ($p < 2.2e-16$) and this indicates a significant model.

We also deduce the following from the above table:

$$\text{Total effect } (\hat{C}_{\text{direct effect}}) = 2.3305$$

$$\text{Std. Error } (S_{\hat{C}}) = 0.1016$$

$$\text{Upper Confidences Limits (UCL)} = \hat{C}_{\text{direct effect}} + Z^{*}S_{\hat{C}}$$

$$= 2.3305 + 1.96\ (0.1016)$$

$$= 4.3921$$

$$\text{Lower Confidences Limits (LCL)} = \hat{C}_{\text{direct effect}} - Z^{*}S_{\hat{C}} = 2.1313$$

$$Y = \Upsilon_2 + C`X + bM + e_2 \qquad \ldots\ldots\ldots\ldots (2)$$

Equation 2 represents the direct effect with the mediating effect

Parameters	$\hat{C}`$	$\hat{b}$
Estimate	1.5673	0.3072
Std. Error	0.4023	0.1572
T value	3.896	1.954
Pr(>|t|)	0.000583	0.061093

Residual standard error	52.55
Multiple R-squared	0.9558
Adjusted R-squared	0.9525
F-statistic	291.7
p-value	< 2.2e-16

Table (3): Partial effect with mediation .

Table No. (3) represents an estimate of the partial effect of (1.567), the standard error of (0.402), and the estimate of (mediating effect) of (0.307), and the standard error of (0.157), and there is a significant effect at a rate of $p < 0.05$.

The overall error of the model was estimated at (52.55) and the coefficient of determination was at (0.955), while the importance of the model in general was (p < 2.2e-16) and this indicates a significant model.

Partial effect ($\hat{C}$`) = 1.5673

Std. Error ($S_{\hat{C}}$`) = 0.4023

Upper Confidences Limits (UCL) = Partial effect ($\hat{C}$`) + $Z^*S_{\hat{C}}$`

= 1.5673+ 1.96 (0.4023) = 2.355

Lower Confidences Limits (LCL) = Partial effect ($\hat{C}$`) - $Z^*S_{\hat{C}}$` = 0.778

$\hat{b}_{indirect\ effect}$ = 0.3072

Std. Error ($S_{\hat{b}}$) = 0.1572

Upper Confidences Limits (UCL) = $\hat{b}_{indirect\ effect}$ + $Z^*S_{\hat{b}}$

= 0.3072+ 1.96 (0.1572)

= 0.615

Lower Confidences Limits (LCL) = $\hat{b}_{indirect\ effect}$ - $Z^*S_{\hat{b}}$

= -0.000912

$$M = \gamma_3 + aX + e_3 \quad \text{..... (3)}$$

The above equation represents the effect of the independent variable on the mediation variable

Parameters	â
Estimate	2.4844
Std. Error	0.1164
T value	21.35
Pr(>|t|)	<2e-16

Residual standard error	63.18
Multiple R-squared	0.9421
Adjusted R-squared	0.94
F-statistic	455.6
p-value	< 2.2e-16

Table (4): Estimates of the coefficient of a ̂

Through Table (4), we note that the estimation of the total effect directly on the income ratio is (2.48) and with a standard error of (0.1164), where there is a significant effect with a percentage of p < 0.05.

Also, the overall error of the model was calculated by (63.18) and the coefficient of determination was (0.94), while the significance of the model in general is (p < 2.2e-16) and this indicates an important model. Based on the results of the above table, we get the following estimates:

$\hat{a}_{direct\ effect}$ = 2.4844

Std. Error ($S_{\hat{a}}$) = 0.1164

Upper Confidences Limits (UCL) = $\hat{a}_{direct\ effect}$ + $Z^*S_{\hat{a}}$

= 2.4844+ 1.96 (0.1164) = 0.7125

Lower Confidences Limits (LCL) = $\hat{a}_{direct\ effect}$ - $Z^*S_{\hat{a}}$

= 0.2562

كما وضحنا يجب ان تتحقق المعادلة

$\hat{a}_{indirect\ effect} * \hat{b}_{indirect\ effect} = \hat{C}_{direct\ effect} - \hat{C}`_{partial\ effect}$

وهي كذلك

$\hat{a}_{indirect\ effect} * \hat{b}_{indirect\ effect}$ = 2.4844*0.3072 = 0.7632

$\hat{C}_{direct\ effect} - \hat{C}`_{partial\ effect}$ = 2.3305-1.5673= 0.7632

In the case of using another method, represented by the (bootstrapping) method, in order to obtain more accuracy in estimating confidence intervals, and for the application, a sample of a size of 1500 was selected from a population of a size of 5000, taking into account the case of return and replacement and calculating each intermediate effect.

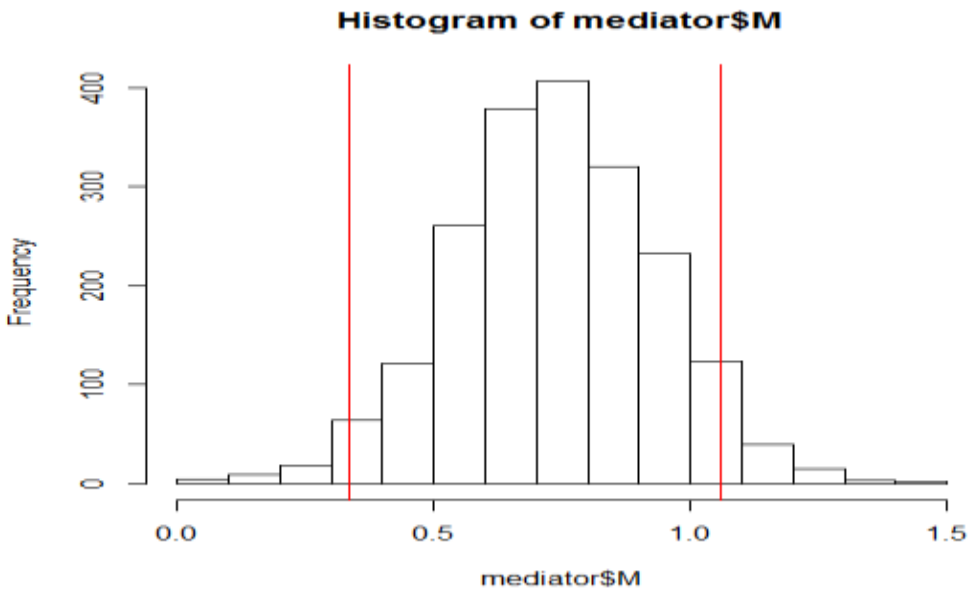


Figure (4): Represents the bootstrap method

CONCLUSIONS

By following the correlation matrix between the variables that were dealt with in this study, as well as the results of estimating the parameters, the estimated confidence intervals, we prove that the smoothing method is better than the multiplication method, as well as the steps of mediation analysis. Where smoothing is based on large resampling with insufficient substitution making different values for the parameter estimates of interest, we get a period of estimates rather than a single point estimate. Therefore, it is preferable to use the smoothing technique in the delta method, and also the steps of mediation analysis.

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