

An Empirical Investigation of the Determinants of Vending Machine Sales Volume

Maxim Mnyakin

Department of International Cooperation,
Saint Petersburg State University, Russia

RECEIVED
27 October 2020
REVISED
16 November 2020

Keywords: Healthy, Payment, Promotion, Regression, Sales volume, Vending machine,

ACCEPTED FOR PUBLICATION
4 January 2021
PUBLISHED
15 January 2021

Abstract

Sales volume is an important measure of a vending machine company's overall performance and profitability. Vending machine operators may monitor the effectiveness of their devices and discover areas for development by analyzing sales data. Understanding the variables influencing sales volume may assist vending machine operators in making educated choices regarding machine placement, product selection, price, and marketing initiatives. In order to acquire information and insights regarding the vending machine sector, we conducted a survey of 251 vending machine operators. We employed regression analysis to evaluate the influence of numerous factors on a certain result, more particularly, the impact of operator attributes on their sales volume. According to the conclusions of this research, vending machine operators may utilize a range of tactics to enhance sales. Operators can keep improving the performance of their business and achieve long-term success by optimizing machine location, offering a wide variety of high-quality products at reasonable prices, regularly maintaining and modernizing the vending machine, implementing marketing and advertising campaigns, and assessing and responding to competitors.

Introduction

Vending machines are now commonplace in public settings such as shopping malls, airports, and office buildings. These self-service devices make it easy for companies to sell their goods and for consumers to make purchases. A vending machine is a self-service machine that delivers food, drinks, and other minor consumer goods when a customer puts money or a credit card into it. Vending machines are intended to be easy and accessible to consumers. Vending machines may sell a broad range of commodities, such as beverages, snacks, sweets, and other small items. Convenience is one of the primary advantages of vending machines. These machines are open 24 hours a day, seven days a week, enabling clients to buy things at their leisure. This is particularly helpful for persons who do not have access to conventional retail outlets or who are in a hurry and cannot wait in line [1]–[3]. Vending machines are also fairly simple to use. Customers may make a purchase by just pressing a few buttons or inserting cash

or a credit card. Because of their simplicity of use, vending machines can service a large number of clients in a short period of time, enhancing corporate efficiency.

Vending machines also have the capacity to take contactless payment methods such as NFC and QR code scanning. This may help lower the danger of germ and viral transmission, particularly during times of increased public health concern. Another advantage of vending machines is the large range of items they provide. Vending machines may give clients with a variety of alternatives to fit their requirements and interests, ranging from beverages and snacks to candies and other minor goods. This is particularly valuable in areas where conventional shopping alternatives are limited. Vending machines may help companies save money on labor expenditures in addition to the advantages they provide to consumers. These devices do not need the presence of a salesman, which may save operational expenses dramatically.

For enterprises, sales volume is an essential measure. It refers to the total quantity of products or services sold by a company during a certain time period, such as a month or a year [4]–[6]. High sales volume usually implies that a company is doing well and can fulfill demand for its goods or services. Low sales volume, on the other hand, may signal that a company is failing and needs to find strategies to stimulate demand for its goods or services. Sales volume, in addition to being a measure of a company's overall success and profitability, may also be used to anticipate future performance and make strategic choices.

Understanding the variables influencing sales volume may assist vending machine operators in making educated choices regarding machine placement, product selection, price, and marketing initiatives. For example, if a vending machine is in a low-traffic area, the operator may need to consider relocating the machine to a more prominent place to enhance sales.

Knowing a vending machine's sales volume may also assist operators choose the optimum pricing approach for their items. For example, if a machine routinely sells a large volume of a certain product, the operator may be able to modestly raise the price while still maintaining good sales.

Hypotheses development

Concerns regarding the detrimental influence of unhealthy food and beverage selections on public health have grown in recent years. As a consequence, many individuals are looking for healthier alternatives for snacking and meal preparation. This trend has also had an influence on the vending machine sector, as more and more customers choose healthier alternatives while making vending machine purchases [7].

Vending machine owners may profit on this trend by providing a greater range of healthy alternatives in their machines. This might include foods like fruits, almonds, yogurt, and other low-calorie, low-saturated-fat snacks. Vending machine owners may attract a broader spectrum of consumers, including those searching for healthier snack alternatives, by providing these options [8], [9]. The above debate has led to the following hypothesis:

Hypothesis 1. Offering healthy foods has positive impact on vending machine sales

The process of customizing a product or service to a particular local market, known as localization, may have a substantial influence on vending machine sales. Allowing vending machines to provide items that are popular or desirable in the local market is one way that localization might affect vending machine sales. A vending machine in a beach resort town, for

example, may have a larger sales volume if it is filled with commodities like sunscreen, beach towels, and mineral water, rather than products that are not as relevant to the local market.

Furthermore, localization might affect vending machine revenues by making the machine more accessible to local clients. For example, if a vending machine is situated in a busy metropolitan location, it may have better sales if it allows mobile payments or provides a larger choice of items that appeal to the demands of busy city people, such as fresh sandwiches or salads. As a consequence, we recommend the following hypothesis:

Hypothesis 2. localization has positive impact on vending machine sales

Any vending machine company that wants to be successful must prioritize regular and thorough maintenance. Vending machine owners can guarantee that their machines are running correctly and delivering a great experience for customers if they clean and repair them on a regular basis. This, in turn, has the potential to have a favorable influence on the sales made by vending machines.

One of the most important advantages of proper maintenance is that it contributes to the smooth and productive operation of vending machines, which is one of its key benefits [10], [11]. This may assist lower the likelihood of a malfunction or failure, which can result in irritated customers and lost business. The operators of vending machines may make their machines last longer and reduce the likelihood that they will need to be replaced by saving money on routine cleaning and maintenance by cleaning and maintaining them on a regular basis.

In addition to ensuring that the vending machines are running as they should, appropriate maintenance is also vital for ensuring that the machines have an appealing look. Customers are more inclined to use a vending machine that is clean, well-maintained, and in good working order rather than one that is unclean or broken. Vending machine operators have the ability to enhance the overall customer experience and perhaps boost sales if they take the effort to ensure that their machines are kept clean and in excellent working order.

When seen as a whole, the effect that proper maintenance has on the sales generated by vending machines is likely to be beneficial. Vending machine owners can guarantee that their machines are running properly, prolong the lifetime of their machines, and enhance the aesthetic of their machines, all of which may help to attract more customers and boost sales if they clean and repair their machines on a regular basis. Thus:

Hypothesis 3. Good maintenance has positive impact on vending machine sales

In recent years, there has been a significant shift toward the use of digital payment options such as debit and credit cards, digital payment apps, and contactless payment technologies such as NFC and scanning QR codes [12], [13]. These payment methods have a number of advantages, including convenience, security, and lower transaction costs. The ease of use, swiftness, and sense of safety offered by these various methods of payment have contributed to their meteoric rise in popularity.

It is possible that the introduction of digital payment methods will have a considerable effect on the revenue generated by operators of vending machines. Customers who would rather pay with their credit cards or mobile devices than with cash might be enticed to patronize businesses

that provide these alternative payment methods. This may prove to be particularly helpful in settings where the use of cash is relatively infrequent or where consumers may not have cash on hand.

In addition to luring a broader spectrum of clients, offering digital payment choices may also serve to contribute to an overall improvement in the quality of the experience for those customers. Customers have the ability to make purchases in a more timely and convenient manner by using digital payment options, which may lead to higher customer satisfaction and subsequent repeat purchases.

Another benefit that operators of vending machines may reap from the use of digital payment choices is that these options have the potential to lower the risk of theft and fraud. It is possible for operators to lessen their exposure to potential financial losses caused by theft or fraud if they do not require consumers to touch cash.

It is anticipated that the introduction of digital payment methods will have a favorable effect on the revenue generated by vending machine sales. Vending machine owners and operators may appeal to a greater variety of consumers, enhance the overall experience for those customers, and perhaps lower the risk of theft and fraud if they include the aforementioned payment methods. It is probable that an increasing number of vending machine operators will implement these choices in order to remain competitive and enhance their company performance. This is because the usage of digital payment methods is expected to continue to expand in the coming years. Therefore, the following hypothesis is proposed:

Hypothesis 4: Having digital payment options has positive impact on vending machine sales

Promotion refers to the many efforts that a company engages in to raise awareness and demand for its goods or services. When it comes to vending machines, marketing has the potential to have a substantial influence on the number of sales.

Advertising is one of the ways that marketing may have an effect on the sales made by vending machines. A firm that sells vending machines may reach more people and raise more people's awareness of the things it sells by using a variety of advertising methods, such as print commercials, radio ads, and web marketing [14], [15]. This may assist to enhance sales by drawing more people to the vending machines where they are located.

The use of promotional pricing or discounts is yet another method that marketing may have an effect on the sales that are generated by vending machines. A vending machine company may encourage consumers to make purchases and raise the total amount of revenue generated by the firm by providing them with special pricing or discounts on selected items.

In addition, promotion may have an effect on sales generated by vending machines via the use of various marketing methods such as branding and packaging. A vending machine company may distinguish its items and make them more enticing to consumers by building a strong brand image for the company and utilizing beautiful packaging for the products. This may result in higher levels of sales.

When taken as a whole, marketing is a significant role in the success of the sales made by vending machines. A vending machine company may improve awareness of its goods, attract consumers, and boost sales by using a number of promotional methods and strategies.

Hypothesis 5. Promotion has positive impact on vending machine sales

Model

In multiple regression, we make the assumption that the variable we want to predict is a linear combination of all of the other variables. We may describe the model as follows if x_{nj} is the j^{th} predictor for observation n :

$$y_n = \beta_0 + \beta_1 x_{n1} + \cdots + \beta_D x_{nD} + \epsilon_n.$$

This may be expressed more concisely as

$$y_n = \boldsymbol{\beta}^\top \mathbf{x}_n + \epsilon_n.$$

When dealing with matrices rather than sums, it is simpler to minimize this loss function. With, define \mathbf{y} and \mathbf{X} [16]–[22] [16], [18], [23]–[25].

$$\mathbf{y} = \begin{bmatrix} y_1 \\ \vdots \\ y_N \end{bmatrix} \in \mathbb{R}^N, \quad \mathbf{X} = \begin{bmatrix} \mathbf{x}_1^\top \\ \vdots \\ \mathbf{x}_N^\top \end{bmatrix} \in \mathbb{R}^{N \times (D+1)},$$

The loss function may be written similarly as:

$$\mathcal{L}(\hat{\boldsymbol{\beta}}) = \frac{1}{2} (\mathbf{y} - \mathbf{X}\hat{\boldsymbol{\beta}})^\top (\mathbf{y} - \mathbf{X}\hat{\boldsymbol{\beta}}).$$

Following the sales literature, we applied the following multivariate regression model to test the hypotheses:

$$\begin{aligned} Sales_i = & \alpha + \beta_1 Healthy_i + \beta_2 Localization_i + \beta_3 Maintenance_i + \\ & \beta_4 Payment_i + \beta_5 Promotion_i + \epsilon_i \end{aligned}$$

Results

As can be seen in Table 1, the presence of healthy food alternatives in vending machines has a beneficial effect on sales. This is due to the fact that an increasing number of customers are looking for better snacking options. Vending machine owners have the opportunity to possibly raise sales and enhance their overall company performance if they provide customers with a greater variety of healthier alternatives, as well as promote these items via various marketing and advertising initiatives. The long-term advantages of stocking vending machines with healthy alternatives and implementing marketing efforts to promote these items may be substantial, despite the fact that the initial outlay may be rather challenging to come up with. Vending machine owners have the ability to enhance sales and attract a larger client base by catering to the rising demand for solutions that are better for their health. The owners of vending machines should think about promoting healthier alternatives by running marketing and advertising efforts in addition to providing customers with a larger selection of healthier options to choose from. This may involve drawing attention to the healthy alternatives that are offered in their vending machines via the use of social media, in-store signage, and other marketing strategies.

The widespread use of digital payment methods, such as debit and credit cards, mobile payment applications, and technology that facilitate contactless transactions, is anticipated to have a beneficial effect on the amount of money spent at vending machines. Vending machine owners may attract a larger variety of consumers, including those who would rather not use cash, by providing these other ways of payment in their machines.

Vending machine operators are no exception to the rule that promotion is an essential component of every successful company. The operators of the machines may enhance their sales and attract more clients if they promote both the equipment and the things that they sell.

Vending machine owners may advertise their machines in a number of ways, including the more typical methods of marketing and promotion, as well as by considering the possibility of forming partnerships with other local companies or groups. For instance, operators can collaborate with educational institutions or fitness centers to advertise nutritious snacks and beverages in vending machines. Alternatively, they can form partnerships with coffee shops or other retailers to offer products that are complementary to those of their partners.

The effect of the promotion on the sales made by vending machines is shown to be positive on the whole. The operators of vending machines may boost their sales and the number of clients they serve by using a wide range of marketing and promotion strategies. Operators have the ability to increase the performance of their businesses and achieve success over the long term if they remain current with the latest trends in their industries and use successful marketing tactics.

Figure 1. positive relations between healthy food offering and localization on vending machine sales

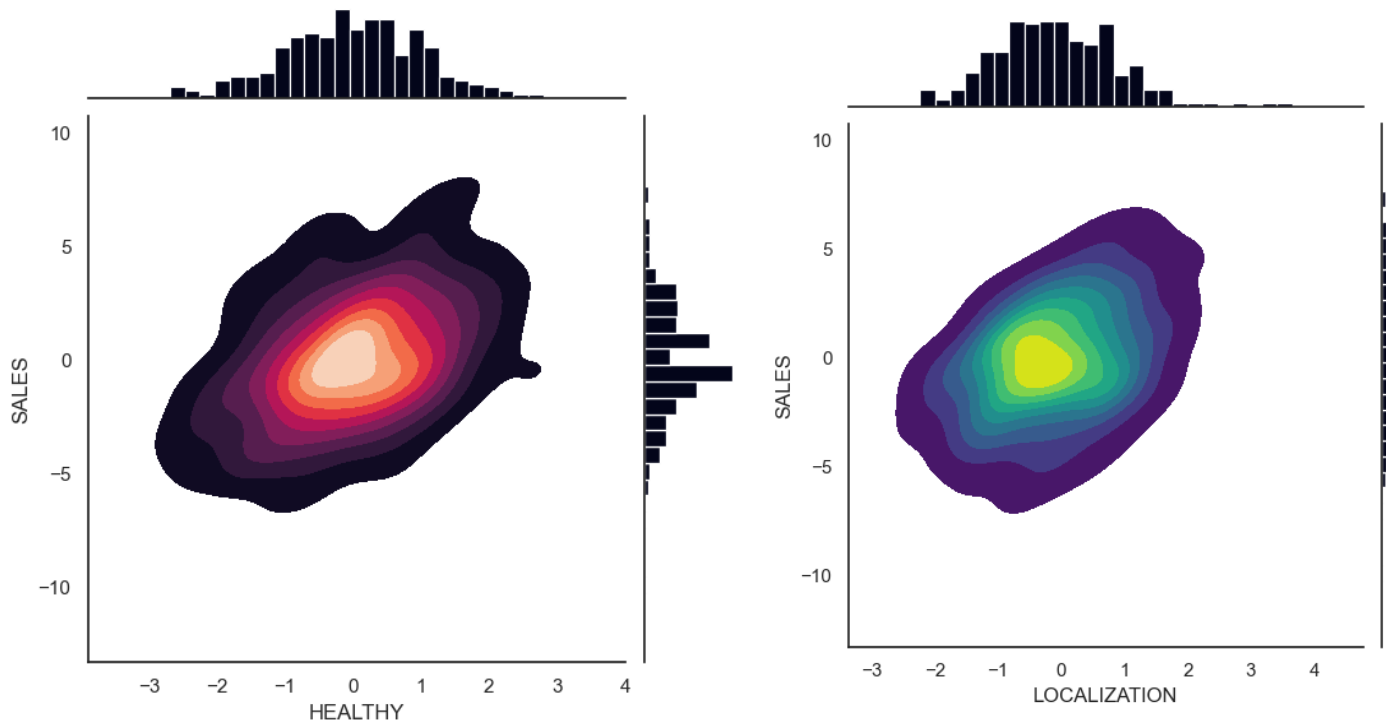


Table 1 also shows that localization can perform a significant role in the success of vending machine sales by enabling the machine to better accommodate the requirements and preferences of the local market. This is shown by the fact that localization enables the machine to better meet the needs and preferences of the local market. A vending machine's sales volume and profitability may be increased if it provides items that are both relevant and convenient and sells them at prices that are comparable to those of its competitors.

Vending machine operators may guarantee that their machines are operating effectively and without any hiccups by doing routine maintenance on their devices on a consistent basis. This has the potential to help avoid a malfunction or breakdown, both of which may result in dissatisfied customers and lost revenue. In addition, vending machines may have a longer lifetime if they are properly maintained, which will result in savings on the cost of replacements in the future.

Table 1. Least Squares regression results

Dependent Variable: SALES
Method: Least Squares
Sample: 1 251
Included observations: 251

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HEALTHY	0.986697	0.068175	14.47305	0.0000
LOCALIZATION	0.974566	0.072585	13.42654	0.0000
MAINTENANCE	1.016573	0.074249	13.69148	0.0000
PAYMENT	1.114413	0.072408	15.39079	0.0000

PROMOTION	1.049743	0.063561	16.51545	0.0000
C	0.021511	0.069102	0.311290	0.7558
R-squared	0.822251	Mean dependent var	-0.044227	
Adjusted R-squared	0.818624	S.D. dependent var	2.546563	
S.E. of regression	1.084538	Akaike info criterion	3.023799	
Sum squared resid	288.1744	Schwarz criterion	3.108073	
Log likelihood	-373.4867	Hannan-Quinn criter.	3.057713	
F-statistic	226.6700	Durbin-Watson stat	1.844657	
Prob(F-statistic)	0.000000			

Figure 1. Normality test

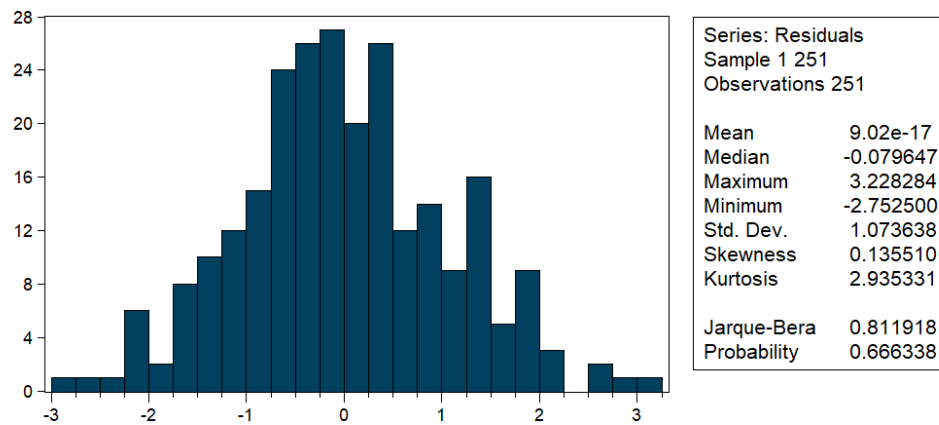


Table 2. Variance Inflation Factors

Sample: 1 251

Included observations: 251

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
HEALTHY	0.004648	1.010269	1.010239
LOCALIZATION	0.005269	1.024094	1.014417
MAINTENANCE	0.005513	1.005481	1.003934
PAYMENT	0.005243	1.022965	1.016309
PROMOTION	0.004040	1.009797	1.009517
C	0.004775	1.018973	NA

Conclusion

Businesses may sell items to clients in a method that is both easy and effective by using vending machines. Customers can also make purchases using these machines. Vending machines provide several advantages to both customers and companies, including their accessibility twenty-four hours a day, seven days a week, their user-friendliness, the breadth of their product offerings, and the convenience with which they may be paid for. However, in order to achieve financial success, owners of vending machines need to be proactive in their search for new methods to boost sales. This study comes to a close by suggesting a few different approaches that proprietors of vending machines can think about using in order to increase revenue. First, they have the ability to optimize the position of the equipment. The placement of a vending machine is one of the most critical aspects that might influence the amount of money made from the machine. When choosing a site for their machines, owners and operators need to think about a variety of criteria, including foot traffic, accessibility to areas with high customer demand, and other similar businesses. Operators have the ability to boost the exposure of their machines and maybe attract more consumers if they choose a location that has a high volume of foot traffic.

Second, they are able to provide a diverse selection of high-quality items at costs that are comparable to those of their competitors. Customers are more likely to make a purchase from a vending machine if the machine provides a diverse selection of items that cater to their individual requirements and inclinations. In order to attract a larger customer base, business owners should think about selling a variety of products, such as alcoholic and nonalcoholic beverages, snacks, candies, and other bite-sized goods. In addition, providing items of excellent quality at costs that are comparable to those offered by competitors may assist to increase sales and inspire customers to return. Third, they should update and keep the vending machine in good working order on a regular basis. Any vending machine company that wants to be successful must prioritize regular and thorough maintenance. The ability of operators to clean and repair their machines on a regular basis allows them to guarantee that their machines run smoothly and effectively, which in turn may enhance the overall experience for customers and lead to an increase in sales. In addition, in order for operators to maintain their competitive edge and appeal to clients, they have to give some thought to modernizing their equipment with new features or technology.

Last but not least, marketing vending machines and the goods they dispense may assist to increase the number of consumers and therefore the number of sales. To increase consumers' familiarity with their vending machines and the goods they have to offer, operators may make use of time-honored marketing and advertising strategies, such as print and online advertisements, social media, and in-store signage. In addition, business owners might examine the possibility of luring clients into making more purchases by giving exclusive deals and discounts.

References

- [1] J. R. DiFranza, J. A. Savageau, and B. F. Aisquith, "Youth access to tobacco: the effects of age, gender, vending machine locks, and 'it's the law' programs," *Am. J. Public Health*, vol. 86, no. 2, pp. 221–224, Feb. 1996.
- [2] S. Park, W. M. Sappenfield, Y. Huang, B. Sherry, and D. M. Bensyl, "The impact of the availability of school vending machines on eating behavior during lunch: the Youth

- Physical Activity and Nutrition Survey,” *J. Am. Diet. Assoc.*, vol. 110, no. 10, pp. 1532–1536, Oct. 2010.
- [3] R. Anupindi, M. Dada, and S. Gupta, “Estimation of Consumer Demand with Stock-Out Based Substitution: An Application to Vending Machine Products,” *Marketing Science*, vol. 17, no. 4, pp. 406–423, Nov. 1998.
- [4] H. Gierl, M. Plantsch, and J. Schweidler, “Scarcity effects on sales volume in retail,” *The International Review of Retail, Distribution and Consumer Research*, vol. 18, no. 1, pp. 45–61, Feb. 2008.
- [5] M. R. Czinkota and W. J. Johnston, “Exporting: Does Sales Volume Make a Difference?,” *Journal of International Business Studies*, vol. 14, no. 1, pp. 147–153, Mar. 1983.
- [6] D. Lee and K. Hosanagar, “Impact of recommender systems on sales volume and diversity,” 2014.
- [7] A. M. Carrad, J. C.-Y. Louie, M. Milosavljevic, B. Kelly, and V. M. Flood, “Consumer support for healthy food and drink vending machines in public places,” *Aust. N. Z. J. Public Health*, vol. 39, no. 4, pp. 355–357, Aug. 2015.
- [8] M. A. Matthews and T. M. Horacek, “Vending machine assessment methodology. A systematic review,” *Appetite*, vol. 90, pp. 176–186, Jul. 2015.
- [9] M. V. Brown, M. Flint, and J. Fuqua, “The effects of a nutrition education intervention on vending machine sales on a university campus,” *J Am. Coll. Health*, vol. 62, no. 7, pp. 512–516, 2014.
- [10] J. Nietupski, P. Clancy, and C. Christiansen, “Acquisition, Maintenance and Generalization of Vending Machine Purchasing Skills by Moderately Handicapped Students,” *Educ. Train. Ment. Retard.*, vol. 19, no. 2, pp. 91–96, 1984.
- [11] A. Orso, M. J. Harrold, D. Rosenblum, G. Rothermel, M. L. Soffa, and H. Do, “Using component metacontent to support the regression testing of component-based software,” in *Proceedings IEEE International Conference on Software Maintenance. ICSM 2001*, 2001, pp. 716–725.
- [12] A. Solano, N. Duro, R. Dormido, and P. González, “Smart vending machines in the era of internet of things,” *Future Gener. Comput. Syst.*, vol. 76, pp. 215–220, Nov. 2017.
- [13] S. Gruber, R. Buber, B. Ruso, and J. Gadner, “The commodity vending machine,” *InForum Ware International*, vol. 2, pp. 32–42, 2005.
- [14] L. K. Goldman and S. A. Glantz, “Evaluation of antismoking advertising campaigns,” *JAMA*, vol. 279, no. 10, pp. 772–777, Mar. 1998.
- [15] L. Dorfman and L. Wallack, “Advertising health: the case for counter-ads,” *Public Health Rep.*, vol. 108, no. 6, pp. 716–726, Nov-Dec 1993.
- [16] J. Salah and M. Darus, “A subclass of uniformly convex functions associated with a fractional calculus operator involving Caputo’s fractional differentiation,” *Acta Universitatis Apulensis. Mathematics-Informatics*, 2010.
- [17] H. U. Rehman, M. Darus, and J. Salah, “A note on Caputo’s derivative operator interpretation in economy,” *J. Appl. Math.*, 2018.
- [18] H. Rehman, M. Darus, and J. Salah, “Coefficient properties involving the generalized k-Mittag-Leffler functions,” *tjmm.edyopress.ro*, 2017.
- [19] J. Y. Salah, “A note on gamma function,” *researchgate.net*, 2015.
- [20] J. Salah, “Fekete-szegő problems involving certain integral operator,” *ijmtjournal.org*, 2014.
- [21] J. Y. M. Salah, “Two Conditional proofs of Riemann Hypothesis,” *researchgate.net*, 2020.
- [22] J. Salah, “A note on the modified Caputo’s fractional calculus derivative operator,” *Far East J. Math. Sci.*, vol. 100, no. 4, pp. 609–615, Sep. 2016.
- [23] J. Salah and S. Venkatesh, “Inequalities on the Theory of Univalent Functions,” *Journal of Mathematics and System*, 2014.

- [24] M. Verbeek, *A Guide to Modern Econometrics*, 3rd ed. Chichester, England: John Wiley & Sons, 2008.
- [25] F. Hayashi, *Econometrics*. Princeton, NJ: Princeton University Press, 2011.