Vol.4.Issue.1.2016 (Janurv-March)

BULLETIN OF MATHEMATICS AND STATISTICS RESEARCH

A Peer Reviewed International Research Journal

http://www.bomsr.com

RESEARCH ARTICLE

ISSN:2348-0580

ACQUISITION OF PERSONAL ASSETS THROUGH A SET OF REGULAR INSTALLMENTS VERSUS DEFERRED REGULAR INSTALLMENTS.WHAT IS THE BEST OPTION?

GARCÍA-SANTILLÁN, ARTURO[1]*, MORENO-GARCÍA, ELENA[1], ORTIZ-RIVERA, LEYVID[2], LANZA-VILORIO, MA. FERNANDA[2], LIRA-MARTINEZ, ALEJANDRA[2]

[1]Professors Researchers in UCC Business School at Universidad Cristóbal Colón, México

[2]Bachelor in Strategic Marketing undergraduate student at UCC Business School Universidad Cristóbal Colón, Veracruz México[2]

LEYVID ORTÍZ RIVERA

ALEJANDRA LIRA MARTÍNEZ

MARYFER LANZA VILORIO

ABSTRACT

The aim of this essay is to demonstrate by means of using a mathematical model, the relevance of paying a debt through a regular payments scheme and a scheme with deferment over time; this last one, in order to pay the first of the overdue installments with *k-1.* The hypothetical scenario focuses on the acquisition of an automobile in both forms of payment. The final result lead us to believe that although the payment form may seem similar, with deferred payment instead of supporting the debtor, it becomes an additional charge of hidden interests that in the final payment is reflected on the total amount paid for such operation.

2000 AMS Subject classification: 62P, 62P05, 97M, 97M30.

1. INTRODUCTION

Nowadays, people may use a model of annuities to pay a set of periodical payments or otherwise, to perform a set of deposits for the creation of an investment fund. Therefore, it is very important to identify which is the best option for both, paying off a debt or saving money.

In the financial mathematics field, the theory proposes several theorems that allow us to value money over time, as noted above, either for investment or savings, as well as for the acquisition of credit or financing among many other operations that are performed in financial institutions within the Mexican Financial System.

In commercial practice, we may observe that the automobile agencies offer several ways to purchase a vehicle, one of this, is attractive discounts by cash payment or by including insurance payment. Other forms may be without interest payments and probably with past due payments schemes and preferential rates.

Finally, there is a scheme of regular installments but with a deferral of time, i.e., the automobile is acquired and begins paying months later. Here what is being discussed is; what is the option that really favors those buyers who purchase the vehicle? In theory, there are several mathematics proposals which can be applied to calculate this kind of financial operations.

Therefore, the objective is to demonstrate if the deferral of the payments which automobile agencies offer to the clients is favorable or not, and if they include hidden interest, which at the end is reflected in the total amount paid for the automobile.

2. REVIEW OF LITERATURE

As noted in the introduction of this essay, in the field of mathematics, there is a branch within this discipline that provides several theorems which allow us to value money over time, such as financial mathematics, whose purpose is assessing operations where money is present.

Some recent work in this field has tried to explain with mathematical models some of the benefits of a deposit scheme that involves different interest rates (Moreno-García, García-Santillán, Guerra-Castro; García-Zárate and Manríquez-Gallardo, 2016), with anticipated annuities and floating interest rate (García-Santillán, Gutiérrez-Delgado, Cristóbal-Hernández and Catalayud-Gutiérrez, 2015), with the modality of simple ordinary annuities and his modality of annuities with geometric gradients (García-Santillán, Moreno-García, Escalera-Chávez, Peña-Osorio and Guerra-Hernández, 2015; García-Santillán, Moreno-García, Saco-Baschkir, Ramos-Hernández, 2015).

Also, mathematical models have demonstrated the acquisitions of real estate through bank loans and how they can be compared with an investment fund, i.e. as a scheme of debt amortization where at the end a high interest payment for the loan obtained is reflected. If on the contrary, instead of paying it is deposited in an investment fund, at the end of the same time, the savings allow us to obtain sufficient resources to acquire real property (Moreno-Garcia, García-Santillán, Abascal-Sánchez, González-Zarco and Galindo-Martínez, 2015).

And finally, once acquired the debt for the acquisition of the automobile, if the debtor does not have the economic resources to pay the fees and falls in the past due portfolio, models for debt restructuring have also been proposed through models of equivalent equations in order to redesign a new scheme to pay the debt.This model of equivalent equations applies to both, overdue promissory notes and for those not yet expired. All this can be done by means of a new scheme with equal payments or with different amounts and different maturity dates (Moreno-Garcia, García-Santillán, Bermúdez-Pérez and Almeida-Fernández, 2015; García-Santillán, Venegas-Martínez and Escalera-Chávez, 2014).

In order to explain theoretically the proposed scenario about purchasing a vehicle, through a series of regular past due payments, we follow the proposal of Ayres (1988), Lopez-Haro (2000), Garcia-Santillán (2007, 2010, 2014), Garcia-Santillán, Edel-Navarro, Escalera-Chavez (2010) whom in their works have proposed to apply an annuities models to identify the periodic payments to be made for each particular case. Furthermore, financial mathematic provides formulas for evaluating several financial operations performed in financial institutions, an example of this is: when a commitment is acquired through the purchase of some real state or personal property, or when establishing a fund of investment is desired.

In summary, for better understanding of the issue regarding past due and deferred annuities, we can refer to what García-Santillán (2014) says about it: “they are those annuities for which payment, deposit, rent and interest payment is made at the end of each period, in comparison with the deferred annuities, which start with the first payment after a time extension, also known as deferral".

Therefore, we developed a financial calculation through payment options in the form of overdue payments and with a deferred first payment, and thereby be able to determine what is the best option.

Development of the case

The hypothetical case analyzed here is about the acquisition of a vehicle, which is acquired with overdue payments. Such payments are constant over time *"n"* with an interest rate *"i"* with *"m"* capitalization, a net value of the transaction that we call *"NPV"* with fixed amounts Rp1 ... .j, and the second case with the same data, except that the variable of the deferral *"k-1"* is added.

In the first scenario, the automobile agency offers their clients the option of paying the car as follows: The cash value of the transaction is $200,000.00, or otherwise, 24 equal payments with a nominal interest rate compound monthly of 18%

Theoretically we know that:

$$NPV = Rp_1\left[\frac{1-(1+i/m)^{-n}}{i/m}\right] \tag{1}$$

Hence, to know the value of each installment, Rp_1 is derived from the formula (1)

Obtaining:

$$Rp_1 = \frac{NPV}{\left[\frac{1-(1+i/m)^{-n}}{i/m}\right]} \tag{1.1}$$

For the development of the case, we have the following:

DATA: *n*= 24 payments; *m*= monthly; i=18%; *NPV*= $200,000.00; Rp_1= ?

$$Rp_1 = \frac{\$200,000.00}{\left[\frac{1-(1+(.18/12)^{-24}}{.18/12}\right]} = \frac{\$200,000.00}{\left[\frac{1-(1+.015)^{-24}}{.015}\right]} \tag{1.2}$$

$$Rp_1 = \frac{\$200,000.00}{\left[\frac{1-0.06995439)}{.015}\right]} = \frac{\$200,000.00}{\left[\frac{.3004561}{.015}\right]}$$

$$Rp_1 = \frac{\$200,000.00}{20.0304066} = \$9,984.81$$

$$\$9,984.81x24 = \$239,635.44$$

The verification with amortization schedule is:

Table 1. Amortization chart

Number of payment	Annuity	Interest	Capital	Balance
0				**$200,000.00**
1	$9,984.82	$3,000.00	$6,984.82	$193,015.18
2	9,984.82	2,895.23	7,089.59	185,925.59
3	9,984.82	2,788.88	7,195.94	178,729.65
4	9,984.82	2,680.94	7,303.88	171,425.77
5	9,984.82	2,571.39	7,413.43	164,012.34
6	9,984.82	2,460.19	7,524.64	156,487.71
7	9,984.82	2,347.32	7,637.50	148,850.20
8	9,984.82	2,232.75	7,752.07	141,098.13
9	9,984.82	2,116.47	7,868.35	133,229.79
10	9,984.82	1,998.45	7,986.37	125,243.41
11	9,984.82	1,878.65	8,106.17	117,137.24
12	9,984.82	1,757.06	8,227.76	108,909.48
13	9,984.82	1,633.64	8,351.18	100,558.30
14	9,984.82	1,508.37	8,476.45	92,081.86
15	9,984.82	1,381.23	8,603.59	83,478.26
16	9,984.82	1,252.17	8,732.65	74,745.62
17	9,984.82	1,121.18	8,863.64	65,881.98
18	9,984.82	988.23	8,996.59	56,885.39
19	9,984.82	853.28	9,131.54	47,753.85
20	9,984.82	716.31	9,268.51	38,485.34
21	9,984.82	577.28	9,407.54	29,077.80
22	9,984.82	436.17	9,548.65	19,529.14
23	9,984.82	292.94	9,691.88	9,837.26
24	9,984.82	147.56	9,837.26	0.00
Total	$239,635.68	$39,635.69	$200,000.00	

Source: own

For the second scenario, the car dealership gives the option to start their payments after the seventh month in a regular payment modality (k-1).

Theoretically we know that:

$$NPV = Rp_1 \left[\frac{1-(1+i/m)^{-n}}{i/m(1+i/m)^{k-1}} \right] \tag{2}$$

Hence, to know the value of each installment with deferral, Rp_1 is derived from the formula (2)
Obtaining:

$$Rp_1 = \frac{NPV}{\left[\dfrac{1-(1+i/m)^{-n}}{i/m(1+i/m)^{k-1}} \right]} \tag{2.1}$$

For the development of the case, we have the following:
DATA: n= 24 payments; m= monthly; i=18%; NPV= $200,000.00; k-1=7; Rp_1= ?

$$Rp_1 = \frac{\$200,000.00}{\left[\dfrac{1-(1+(.18/12)^{-24}}{.18/12(1+(.18/12)^{7-1}} \right]} = \frac{\$200,000.00}{\left[\dfrac{1-(1+(.015)^{-24}}{.015(1+(.015)^{7-1}} \right]} \tag{2.2}$$

$$Rp_1 = \frac{\$200,000.00}{\left[\frac{1-.6995439}{.015(1.0934432}\right]} = \frac{\$200,000.00}{\left[\frac{.3004561}{.0164016}\right]}$$

$$Rp_1 == \frac{\$200,000.00}{18.3187067} = \$10,917.80$$

$$\$10,917.80x24 = \$262,027.20$$

The verification with amortization schedule is:

Table 2. Amortization chart

Number of payment	Annuity	Interest	Capital	Balance
0				$200,000.00
1	$0.00	$3,000.00		203,000.00
2	0.00	3,045.00		206,045.00
3	0.00	3,090.68	*k-1*	209,135.68
4	0.00	3,137.04		212,272.71
5	0.00	3,184.09		215,456.80
6	0.00	3,231.85		218,688.65
7	10,917.83	3,280.33	7,637.50	211,051.15
8	10,917.83	3,165.77	7,752.07	203,299.08
9	10,917.83	3,049.49	7,868.35	195,430.73
10	10,917.83	2,931.46	7,986.37	187,444.36
11	10,917.83	2,811.67	8,106.17	179,338.19
12	10,917.83	2,690.07	8,227.76	171,110.43
13	10,917.83	2,566.66	8,351.18	162,759.25
14	10,917.83	2,441.39	8,476.45	154,282.80
15	10,917.83	2,314.24	8,603.59	145,679.21
16	10,917.83	2,185.19	8,732.65	136,946.56
17	10,917.83	2,054.20	8,863.64	128,082.93
18	10,917.83	1,921.24	8,996.59	119,086.34
19	10,917.83	1,786.30	9,131.54	109,954.80
20	10,917.83	1,649.32	9,268.51	100,686.29
21	10,917.83	1,510.29	9,407.54	91,278.75
22	10,917.83	1,369.18	9,548.65	81,730.09
23	10,917.83	1,225.95	9,691.88	72,038.21
24	10,917.83	1,080.57	9,837.26	62,200.95
25	10,917.83	933.01	9,984.82	52,216.13
26	10,917.83	783.24	10,134.59	42,081.53
27	10,917.83	631.22	10,286.61	31,794.92
28	10,917.83	476.92	10,440.91	21,354.01
29	10,917.83	320.31	10,597.52	10,756.49
30	10,917.83	161.35	10,756.49	0.00
Total	$262,028.03	$62,028.03	$200,000.00	

Source: own

DISCUSSION AND CONCLUSION

As a result of the analysis for both hypothetical scenarios through modalities of due and deferred annuities, the following results were obtained:

It is clearly evident that both formulas in theory, give us different results, as we can see in Table 3, whether for the ordinary payment, as for ordinary payments with deferral regarding the time the first payment starts.

Table 3 Summary of calculus

Total	Interest payment	NPV	Concept
$239,635.68	$39,635.69	$200,000.00	Regular payment
$262,028.03	$62,028.03	$200,000.00	Regular payment with deferral (*k-1*)
$22,392.35	$22,392.35	$0.00	More interest payment within deferred scheme

Source: own

The idea of stating it into this mathematical essay is to show what in theory indicates about this form of payment deferred: that although it is an attractive scheme to acquire any kind of asset, it is also clear that when an extension is obtained over time, the creditor will necessarily gain interest in the time granted since the financed capital is not recovered during the time period in which the payments are deferred. These assertions are consistent with the several papers presented by García-Santillán *et al* (2007, 2010, 2013 and 2014).

In commercial practice, namely in real life, it may seem that people, when buying a car –if they were given an extension for payment-, think it is without charge, but the fact is it is not, as this document proved. In order to do this, the theoretical guideline that sets out the steps to calculate both proposed scenarios were followed at all times (Moreno-García et al 2014 and García-Santillán et al 2014). Also, we can say that this kind of behavior in some customers, who purchase any personal asset, is associated with a low or zero financial knowledge regarding this kind of operation.

We can think as well that the seller of the assets, probably do not explains to the customer the implications and differences than a payment scheme has over the other, or otherwise, the customer does know this from the beginning of the operation and even then, chooses the second scheme (*k-1*), which is valid and acceptable.

Finally, in this paper the theoretical arguments that support this mathematical essay were stated. Furthermore, this essay aims to be a consultation document, which could help regulate some behaviors and to serve as a support to decision making regarding the acquisition of personal assets.

Acknowledges

The authors are very grateful to the anonymous blind-reviewer for all suggestions, to the UCC Business School at Cristobal Colon University for all their help and support. Also, in a very special way, with our gratitude to Jesica, Ramos-Hernández, doctoral student at UCC Business SchoolUniversidad Cristóbal Colón, for all his suggestions in the grammatical review process.

References

[1]. Ayres, Frank Jr. (1988) *Matemáticas financieras*. México. Ed. McGraw-Hill.

[2]. García-Santillán A., Edel-Navarro R., Escalera-Chávez,M.(2010) "La enseñanza de la matemática financiera: Un modelo didáctico mediado por TIC”. Electronic version at Universidad de MálagaISBN-13:978-84-693-9739-8 Registered at National Library of Spain № 11/4918.

[3]. García-Santillán Arturo: (2007) *Sistema financiero mexicano y el mercado de derivados*, Electronic versión at Universidad de Málaga ISBN: 13-978-84-690-7143-4 Registered at National Library of Spain№ 07/60277.

[4]. García-Santillán, A, Moreno-García, E, Saco-Baschkir, M, Ramos-Hernández, C(2015). A financial mathematical model to calculate a saving scheme through arithmetic and geometric gradient *Bulletin of Mathematics and Statistics Research* Vol. 3 (3) pp. 175-181.

[5]. García-Santillán, A. (2014) *Matemáticas Financieras para la toma de decisión*, Electronic versión at Universidad de Málaga ISBN-13: 978-84-16036-61-5 Registered at National Library of SpainNº 2014/60144.

[6]. García-Santillán, A. Venegas-Martínez, F., Escalera-Chávez, M. (2014). Modeling Restructuring Debt with Equivalent Equations: Theoretical and practical implications.*American Review of Mathematics and Statistics*Vol. 2 (2) pp. 91-106.

[7]. García-Santillán, A. (2010) *AdministraciónFinanciera I*, Electronic versión at Universidad de MálagaISBN-13: 978-84-693-7162-6 Registered at National Library of Spain Nº 10/101867.

[8]. García-Santillán, A.; Gutiérrez-Delgado, L., Cristóbal-Hernández, C., and Catalayud-Gutiérrez, V. (2015) Financial Modeling for investment trough anticipated annuities in scenarios with floating rate interest (How make it?)*American Journal of Applied Mathematics and Statistics*, 2015, Vol. 3, No. 3, 93-99.

[9]. García-Santillán, A; Moreno-García, E; Escalera-Chávez, M; Peña-Osorio, Yand Guerra-Hernández, D (2015) Simple annuities versus annuities scheme with geometric gradient. What is the best investment choice? *Research Journal of Pure Algebra (IRJPA) Vol. 5 (10x) pp. 177-181.*

[10]. López-Haro, Rubén (2000) *Comprendiendo las Matemáticas Financieras*. México Ed. Foundation of the*Universidad de las Américas-Puebla*.

[11]. Moreno-García, E.; García-Santillán, A.; Abascal-Sánchez, Miguel A.; González-Zarco, D and Galindo-Martínez, C. (2015) A comparative financial modeling to evaluate a real state property with mortgage loan versus investment funds. *Bulletin of Mathematics and Statistics Research* Vol. 3 (4) pp. 10-19

[12]. Moreno-Garcia, E.; García-Santillán, A.; Bermúdez-Pérez, A., and Almeida-Fernández, P.C. (2015) Restructuring debt proposal in three hypothetical scenarios: Equal payments, different amounts and one unknown payment, different amounts and three unknown payment. *Journal of Progressive Research in Mathematics* (JPRM) ISSN: 2395-0218 Vol. 4, No. 1 May 21 2015 pp. 233-246

[13]. MORENO-GARCÍA, E; García-Santillán, A; Guerra Castro, M; García Zárate, E; Manríquez Gallardo, S (2015) A financial modeling with advance deposits, in scenarios with different interest rates and terms for investment.*Journal of Progressive Research in Mathematics* (JPRM) ISSN: 2395-0218 Vol. 6 Issue (4) pp849-863

Brief bio of Authors

Leyvid del C. Ortiz-Rivera

Second year student of Bachelor in Strategic Marketing at UCC Business School Universidad Cristóbal Colón, Veracruz México.

Arturo García-Santillán

Researcher Professor at UCC Business School Universidad Cristóbal Colón and member of the National System of Researchers in Mexico CONACYT. He has Postdoctoral Studies in Mathematics (*Escuela Superior de Economía del Instituto Politécnico Nacional* ESE-IPN), Ph.D. in Management (mayor) Financial (minor), MBA (*Universidad Autónoma de Ags.*-México) and Bachelor in Financial Management.He obtained the Fischler award in USA for his research and publications on Financial Mathematics teaching, among others. He published more than one hundred papers in indexing journals, twenty books and six chapter in books.

Elena Moreno-García
Researcher Professor at Universidad Cristóbal Colón. Member of the National System of Researchers in Mexico. She has a PhD in Economics from Almeria University, Spain, a master degree in finance from Universidad de lasAméricas - Puebla and a Bachelor in Economics. She has published more than fifteen papers in indexing journals about math anxiety, financial education and regional and urban economics.

Alejandra Lira-Martinez
Second year student of Bachelor in Strategic Marketing at UCC Business School Universidad Cristóbal Colón, Veracruz México.

Ma. Fernanda Lanza-Vilorio
Second year student of Bachelor in Strategic Marketing at UCC Business School Universidad Cristóbal Colón, Veracruz México.