Repair or Replace: A financial analysis of automobile owners’ dilemma to repair or replace

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**Introduction**

Automobiles are the most commonly used form of transportation method due to their extremely high convenience, comfort and their ability to travel longer short distances where using public transportation is not economical or not viable. Additionally, they give us a sense of ownership and personal space which do not exist while using public transportation methods. Although this is not always environmentally friendly, preferences and tastes make the automobile an attractive purchase.

Every automobile owner, at some point, is faced with the dilemma to repair or replace their automobiles. This dilemma is caused by issues that could include higher fuel consumption, rising operational and maintenance(O&M) costs, damage to the vehicle and rising global warming levels. With more variety available every year, it is often attractive to lease cars for a fixed amount of time after which the lessee has the option to purchase or to lease a newer vehicle. Global warming is another important issue that affects the automobile market. Burning fossil fuels is one the main reason for rising global warming levels. Since most automobiles use fossil fuels, it is safe to assume there will be a shift away from this trend if global warming is to be stopped. Electric vehicles shine here and become a very attractive option to conventional automobile users due to the relatively cheaper fuel costs(sometimes even free) and the subsidies offered by local governments.

With all the issues an automobile owner would face, it would be prudent to perform a financial analysis of owning a car. These costs include fuel, O&M, insurance and inflation. Additionally, there will be some benefit financially in using an automobile. This could be in the form of saving money you would use on other modes of transportation, subsidies and concessions while using Electric vehicles. This project tries to find the real cost of owning a vehicle, and most importantly evaluate options to either repair and keep using your current car or simply sell your old car and purchase a new one. Additionally, the project will analyze the various methods for purchasing a new car. These include taking a bank loan and repaying it with 3 payment plans, leasing(loaning) directly from a dealer, using personal funds upfront to fully purchase the car and taking a bank loan. The aim of the project is to find if purchasing a new vehicle is economically beneficial over repairing and continuing to use the car you own.

**Research**

The following sources were used for collecting data and researching alternatives:

* According to the bureau of labor statistics, the 12-month % change of the Consumer Price Index (CPI) for new vehicles is 0.4% as of February 2020. This means the price of a new car increased by 0.4% from February 2019 to February 2020. This is the inflation rate for this period. The 12-month % change of CPI for all items is 2.3%. ([[1]](#endnote-1))
* According to the bureau of labor statistics, the 12-month % change of the Consumer Price Index (CPI) for used vehicles is -1.3% as of February 2020. This means the prices of used cars reduce by 1.3% every year.([[2]](#endnote-2))
* According to the Massachusetts government, Sales Tax on the purchase of a car is 6.25%.([[3]](#endnote-3))
* The data for the Chevy Impala is obtained from the official Chevy website which gives data for the prices, operational costs and finance options.[[4]](#endnote-4)
* The official website of Tesla for date about prices, loan offers and Operation data[[5]](#endnote-5)
* We will use a Kelley Blue book KBB.com for depreciating and finding the salvage values.
* We use a planning horizon of 6 years which is the average lifetime of a car.

**Current Car**

Since I personally do not own a car, I will assume I drive a car and use financial and ownership data from a friend who drives a car.

* The current car being used is a Chevrolet Impala LT, a 2017 model of the vehicle.
* The cost of the car was $27000. It was purchased in the start of 2017 by making an out of pocket down payment of $2000. The remaining $25000 was borrowed from a bank with a fixed monthly repayment plan of $500 for 5 years. The interest rate on the loan is 0.9% compounded monthly or 10.8% compounded yearly.
* The insurance premium started out at $140 per month but has been reducing by $10 every year.
* The sale tax for purchasing a car in Massachusetts is 6.25% of the total amount paid 20 days after the purchase of the vehicle to the DMV.
* The number of miles completed on the car is 59000. On average this means the car travels 1639 miles per month at 27 Miles per gallon. 60.70 gallons of fuel is required per month/ The average fuel price for premium gasoline is $2.85/gallon. The average monthly fuel costs come up to $173.0056
* If the vehicle was not owned and the commute is shared with a colleague, the monthly amount for travel would be $173/2 = $86.5. These $86.5 are savings as a result of owning a car.
* The maintenance cost which includes oil changes and regular maintenance come up to $60 for every 4 months. Or $15 per month. For a 6-year life, the total Maintenance costs come up to $1080. Since the car has not had any repairs yet, let us assume $1008 are required for repairs over the life. For simplicity, this would be $14 per month.
* Personal MARR(Savings account) for the owner of the vehicle is 1%
* According to Kelley Blue Book, the salvage value of the car is $14563 at the start of 2020[[6]](#endnote-6)

**Alternatives**

Two alternatives are being considered to replace the car:

* The first is to replace the car with a newer version of the vehicle. We would be looking at the Chevrolet Impala LT,2020. The price of the vehicle is $30,995 after discounts and allowances. This includes a freight charge for shipping of $875 which can be avoided by picking up the car personally. The final price of the vehicle is $30,120.[[7]](#endnote-7)
* O&M, fuel and Insurance costs will be estimated from edumunds.com. Over 5 years, Insurance is estimated at $5646 or $94.1/month. Similarly, maintenance and repairs cost $4692 or $78.2/month. Fuel cost would be similar because the vehicle will be used similarly, i.e., $173/ month. And savings of $86.5/month.[[8]](#endnote-8)
* The second alternative is to purchase an electric vehicle of a similar class. For this purpose, we will select the Tesla Model 3 standard range plus.
* The price of the car is $39,990. This does not include a Massachusetts state incentive to purchase an Electric vehicle of $2500. This would bring down the cost to $37,490.
* Additionally, Electric vehicles have the added advantage of having little to zero fuel costs with many free charging stations. Tesla estimates this amount to be between $4300 and $6400 over the average 6-year life of a car.
* The O&M costs and repairs for a Tesla are estimated at $2084 over 5 years of its life or $34.73/month. These include $981 in maintenance and $1,103 in repairs. The insurance for the vehicle over 5 years is estimated at $4,061 or $67.68/month. The fuel costs are estimated at $2549 over 5 years or $42.48/month, this cost includes electricity costs for charging the vehicle. [[9]](#endnote-9)

**Financing options**

Three financing options are considered for each of the two alternatives discussed above.

* 1. The first is to pay the entire amount upfront out of pocket. For the Impala, this amount would be $30,120. For the Tesla, this amount would be $39,990 without including local incentives of $2500
  2. The second is to lease the vehicle from certified dealers. If leased directly from Tesla with a down payment of $2500 for 15000 annual miles for 3 years(mileage charge of $.25/mile over 45000 miles), the lease payment is $501 per month at the end of which the car must be returned and hence will have no salvage value. $3696 is due at signing which include the first month payment, down payment and an acquisition fee of$695. For the Impala, if leased directly from Chevrolet with a down payment of $2500 for 15000 annual miles for 3 years(mileage charge of $.25/mile over 45000 miles), $2941 is due at signing which includes the 1st monthly payment of $471 and the down payment of $2500. The car must be returned after 3 years and hence has no salvage value.
  3. The third option is to borrow money from either a bank or the maker. If borrowing from Tesla with a down payment of $2500, we borrow $37490 @ 2.99% APR. This loan requires 36 monthly payments of $1090 to be paid in full in 3 years. This include a total amount of $39,243.22 out of which $1753.22 is towards interest. Borrowing from Chevy requires a down payment of $2500. We borrow $27620 @ 2.99% APR. The total amount paid back would be $28911.65 out of which $1291.65 would be towards interest payments.

**Analysis**

1. Our first option would be to simply retain the car we are currently using with no replacement

The original cost of the car was : $27000

Initial down payment towards the purchase : $2000

Amount borrowed from bank : $25000 @ 10.8% compounded annually

Monthly payments to bank: $500 for 60 months

Insurance payments: Started at $140/ month has been coming down by $10 every year

Sales tax paid to the Massachusetts DMV : 6.25% = 27000 \* (6.25/100) = $1687.50

Amount spent on fuel: $173/ month

Savings per month : $ 86.5 which is saved by not sharing the daily commute with a colleague

Operation and Maintenance cost : $15+$14 = $29/ month

Salvage(Resale) Value at the end of 2020 = $14562

Monthly net spending : 173+29-86.5= $115.5+ 140= $255.5/ month (reduces by $10 every year)

1. The second option is to replace the current car with a newer version of the car

Final price of the vehicle: $ 30,120

Sales Tax paid to the DMV: 30120\*(6.25/100)= $1882.5

Insurance payments : $94.1/ month

Estimated O&M costs : $78.2/ month

Estimated Fuel costs : $173/ month

Savings on fuel : $86.5/month

Monthly net spending = 94.1+78.2+ 173-86.5= $258.8

Estimated Salvage value @ EOY 6 = Cost- Depreciation for years 1,2, 3 of the car life = 30120-14060-1525-1443= 13092([[10]](#endnote-10))

1. The third option is to replace the current car with an electric vehicle

Final price of the vehicle : $39,990

Sales tax paid to the DMV : $ 39990\*(6.25/100)= $2499.37

State incentive to purchase an electric vehicle: $2500

O&M costs : $ 34.73/ month

Insurance payments: $ 67.68/ month

Estimated cost of electricity for charging : $42.48/ month

Monthly saving by owning the car and not sharing the ride= $21.24/month

Monthly net spending = 34.73+67.68+42.48-21.24= $123.65/month

Salvage Value @ EOY 6 = 69.3% of original price = $27,713. [[11]](#endnote-11)

Salvage Value 6 years after purchasing the car= 48.7% of original price= $19475.13

**Engineering Economy**

**Cash Flow Diagrams**

**Option 1**

No replacement

Initial payment= 2000+1687.50= 3687.50

Monthly payments towards repayment of loan = $500 until EOY 5

Monthly net spending =- $255.5/ month for year 1

-$245.5 for year 2

-$235.5 for year 3

-$225.5 for year 4

-$215.5 for year 5

-$205.5 for year 6

To estimate salvage value in the year 2023, we look at the resale value of the 2014 Impala in the present day= $11258. [[12]](#endnote-12)

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| EOY | Initial Payment | Loan payments | O&M | Salvage Value | CF |
| 0 | -3687.5 |  |  |  | -3687.5 |
| 1 |  | -6000 | -3066 |  | -9066 |
| 2 |  | -6000 | -2946 |  | -8946 |
| 3 |  | -6000 | -2826 |  | -8826 |
| 4 |  | -6000 | -2706 |  | -8706 |
| 5 |  | -6000 | -2586 |  | -8586 |
| 6 |  | 0 | -2466 | 11258 | 8792 |

**Option 2**

Replace with newer version

Payment Plan 1 (One single Payment)

Initial Payment @ EOY 3 = $30,120

Salvage Value of Original Car @ EOY 3 = $14563

Sales Tax due @ EOY 3 = $1882.5

Monthly Net spending = -$258.8

Salvage Value @ EOY 6 = $13092

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| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | EOY | Initial Payment | Loan payments | O&M | Savings over Option 1 | Salvage Value | CF | | 0 | -3687.5 |  |  |  |  | -3687.5 | | 1 |  | -6000 | -3066.6 |  |  | -9066.6 | | 2 |  | -6000 | -2946 |  |  | -8946 | | 3 | -32002.5 | -6000 | -2826.6 |  | 14563 | -26266.1 | | 4 |  | -6000 | -3105.6 | -399.6 |  | -9505.2 | | 5 |  | -6000 | -3105.6 | -519.6 |  | -9625.2 | | 6 |  | 0 | -3105.6 | -639.6 | 13092 | 9346.8 | |  |  |  |  |  |
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Payment Plan 2 (Leasing the Vehicle)

Initial Payment @ EOY 3 = $2500

Sales Tax due @ EOY 3 = $1882.5

Salvage Value of Original Car @ EOY 3 = $14563

Charge for additional miles= 59000-45000= 14000\*$0.25= $3500 or $1166.67/year

Monthly lease payments = $471 for 36 months

Salvage Value @ EOY 6 = 0

Monthly Net spending= $258.8

Salvage Value @ EOY 6= 0

Charge for additional miles= 59000-45000= 14000\*$0.25= $3500 or $1166.67/year

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| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | EOY | One Time Payments | Loan payments | O&M | Savings over Option 1 | Salvage Value | CF | | 0 | -3687.5 |  |  |  |  | -3687.5 | | 1 |  | -6000 | -3066 |  |  | -9066 | | 2 |  | -6000 | -2946 |  |  | -8946 | | 3 | -4382.5 | -6000 | -2826 |  | 14563 | 1354.5 | | 4 |  | -12818.7 | -3105.6 | -399.6 |  | -16323.9 | | 5 |  | -12818.7 | -3105.6 | -519.6 |  | -16443.9 | | 6 |  | -6818.7 | -3105.6 | -639.6 | 0 | -10563.9 | |  |  |  |  |  |
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Payment Plan 3 (Financing the Purchase)

Initial Payment @ EOY 3 = $2500

Sales Tax due @ EOY 3 = $1882.5

Amount Financed = $27620 @ 2.99 APR for 36 months

Salvage Value of Original Car @ EOY 3 = $14563

Monthly payments to loan= $803.10

Sales Tax due @ EOY 3 = $1882.5

Monthly Net spending = $258.8

Salvage Value @ EOY 6 = $13092

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| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | EOY | One Time Payments | Loan payments | O&M | Savings over option 1 | Salvage Value | CF | | 0 | -3687.5 |  |  |  |  | -3687.5 | | 1 |  | -6000 | -3066 |  |  | -9066 | | 2 |  | -6000 | -2946 |  |  | -8946 | | 3 | -4382.5 | -6000 | -2826 |  | 14563 | 1354.5 | | 4 |  | -15637.2 | -3105.6 | -399.6 |  | -19142.4 | | 5 |  | -15637.2 | -3105.6 | -519.6 |  | -19262.4 | | 6 |  | -9637.2 | -3105.6 | -639.6 | 13092 | -290.4 | |  |  |  |  |  |
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**Option 3**

Replacement with Electric Vehicle

Payment Plan 1 (One Single Payment)

Initial Payment @ EOY 3 = $39,990

Sales Tax due @ EOY 3 = $2499.37

State incentive received @ EOY 3 = $2500

Monthly Net spending = $123.65

Salvage Value of original car @ EOY 3 = $14563

Salvage Value of electric car @ EOY 6 = $27713

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| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | EOY | One Time Payments | Loan payments | O&M | Savings over Option 1 | Salvage Value | CF | | 0 | -3687.5 |  |  |  |  | -3687.5 | | 1 |  | -6000 | -3066 |  |  | -9066 | | 2 |  | -6000 | -2946 |  |  | -8946 | | 3 | -39989.4 | -6000 | -2826 |  | 14563 | -34252.4 | | 4 |  | -6000 | -1483.8 | 1222.2 |  | -6261.6 | | 5 |  | -6000 | -1483.8 | 1102.2 |  | -6381.6 | | 6 |  | 0 | -1483.8 | 982.2 | 27713 | 27211.4 | |  |  |  |  |  |
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Payment Plan 2 (Leasing the Vehicle)

Initial Payment @ EOY 3 = $2500 + $695 Acquisition Fee= $3195

Sales Tax due @ EOY 3 = $2499.37

State incentive received @ EOY 3 = $2500

Monthly Net spending = $123.65

Monthly Lease payment = $501

Salvage Value of original car @ EOY 3 = $14563

Salvage Value of electric car @ EOY 6 = 0

Charge for additional miles= 59000-45000= 14000\*$0.25= $3500 or $1166.67/year

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| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | EOY | One Time Payments | Loan payments | O&M | Savings over option 1 | Salvage Value | CF | | 0 | -3687.5 |  |  |  |  | -3687.5 | | 1 |  | -6000 | -3066 |  |  | -9066 | | 2 |  | -6000 | -2946 |  |  | -8946 | | 3 | -3194.37 | -6000 | -2826 |  | 14563 | 2542.63 | | 4 |  | -13261.1 | -1483.8 | 1222.2 |  | -13522.7 | | 5 |  | -13261.1 | -1483.8 | 1102.2 |  | -13642.7 | | 6 |  | -7261.11 | -1483.8 | 982.2 | 0 | -7762.71 | |  |  |  |  |  |
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Payment Plan 3 (Financing the Purchase)

Initial Payment @ EOY 3 = $2500

Amount borrowed = $37490 @ 2.99% APR for 3 years

Monthly Loan Payments = $1090

Salvage Value of Original Car @ EOY 3 = $14563

Sales Tax due @ EOY 3 = $2499.37

State incentive received @ EOY 3 = $2500

Monthly Net spending = $123.65

Salvage Value of electric car @ EOY 6 = $27713

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| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | EOY | One Time Payments | Loan payments | O&M | Savings over option 1 | Salvage Value | CF | | 0 | -3687.5 |  |  |  |  | -3687.5 | | 1 |  | -6000 | -3066 |  |  | -9066 | | 2 |  | -6000 | -2946 |  |  | -8946 | | 3 | -2499.37 | -6000 | -2826 |  | 14563 | 3237.63 | | 4 |  | -19080 | -1483.8 | 1222.2 |  | -19341.6 | | 5 |  | -19080 | -1483.8 | 1102.2 |  | -19461.6 | | 6 |  | -13080 | -1483.8 | 982.2 | 27713 | 14131.4 | |  |  |  |  |  |
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**Cash Flow Analysis**

The interest rate on our savings account is 1% APY. This mean MARR of the person= 1% compounded annually

**Present Worth: (PV=PW-Initial investment)**

Option 1

The MARR is 1%

The PW of the cashflow becomes: -3687.5-9066(P|F,1%,1)-8946(P|F,1%,2)-8826(P|F,1%,3)-8706(P|F,1%,4)-8586(P|F,1%,5)+8792(P|F,1%,6)

= -3687.5-9066/(1.01)-8946/(1.01)^2-8826/(1.01)^3-8706/(1.01)^4-8586/(1.01)^5+8792/(1.01)^6

= -$38253.0122

NPV= NPV(0.01,F3:F8) = -$34565.51 (Using Excel function)

PW= NPV+ Initial Investment

Option 2

*Payment Plan 1*

PW @ 1% MARR = -3687.5-9066(P|F,1%,1)-8946(P|F,1%,2)-26265.5(P|F,1%,3)-9105.6(P|F,1%,4)-9105.6(P|F,1%,5)+9986.4(P|F,1%,6)

= -3687.5-9066/(1.01)-8946/(1.01)^2-26265.5/(1.01)^3-9105.6/(1.01)^4-9105.6/(1.01)^5+9986.4/(1.01)^6

= -$56414.3335

NPV= -52727.43 (Using Excel function)

*Payment Plan 2*

PW @ 1% MARR = -3687.5-9066(P|F,1%,1)-8946(P|F,1%,2)-26265.5(P|F,1%,3)-9105.6(P|F,1%,4)-9105.6(P|F,1%,5)+9986.4(P|F,1%,6)

= -3687.5-9066/(1.01)-8946/(1.01)^2+1354.5/(1.01)^3-15924.3/(1.01)^4-15924.3/(1.01)^5-9924.27/(1.01)^6

= -$61377.79

NPV= -$57715.73 (Using Excel function)

*Payment Plan 3*

PW @ 1% MARR = -3687.5-9066(P|F,1%,1)-8946(P|F,1%,2)+1354.5(P|F,1%,3)-18742.8(P|F,1%,4)-18742.8(P|F,1%,5)+349.2(P|F,1%,6)

= -3687.5-9066/(1.01)-8946/(1.01)^2+1354.5/(1.01)^3-18742.8/(1.01)^4-18742.8/(1.01)^5+349.2/(1.01)^6

= - $57115.3545

NPV = -$53427.85

Option 3

*Payment Plan 1*

PW @ 1% MARR = -3687.5-9066(P|F,1%,1)-8946(P|F,1%,2)-34252.4(P|F,1%,3)-5917.56(P|F,1%,4)-5917.56(P|F,1%,5)+27795.44(P|F,1%,6)

= -3687.5-9066/(1.01)-8946/(1.01)^2-34252.4/(1.01)^3-5917.56/(1.01)^4-5917.56/(1.01)^5+27795.44/(1.01)^6

= -$41,133.29

NPV @ 1% MARR = NPV(1%,F3:F8)= -$37445.79

*Payment Plan 2*

PW @ 1% MARR = -3687.5-9066(P|F,1%,1)-8946(P|F,1%,2)+2542.63(P|F,1%,3)-13178.7(P|F,1%,4)-13178.7(P|F,1%,5)-7178.67(P|F,1%,6)

= -3687.5-9066/(1.01)-8946/(1.01)^2+2542.63/(1.01)^3-13178.7/(1.01)^4-13178.7/(1.01)^5-7178.67.44/(1.01)^6

= -$52018.743

NPV @ 1% MARR = -$48331.24

*Payment Plan 3*

PW @ 1% MARR = -3687.5-9066(P|F,1%,1)-8946(P|F,1%,2)+3237.63(P|F,1%,3)-18997.6(P|F,1%,4)-18997.6(P|F,1%,5)+14715.44(P|F,1%,6)

= -3687.5-9066/(1.01)-8946/(1.01)^2+3237.63/(1.01)^3-18997.6/(1.01)^4-18997.6/(1.01)^5+14715.44/(1.01)^6

= -$42082.58

NPV @ 1% MARR = -$38395.08 (Using Excel)

**Future Worth (FV= FV(NPV(MARR,Returns)+Initial Investment) @ MARR)**

Option 1

The FW of the cashflow becomes: -3687.5(F|P,1%,6)-9066(F|P,1%,5)-8946(F|P,1%,4)-8826(F|P,1%,3)-8706(F|P,1%,2)-8586(F|P,1%,1)+8792(F|P,1%,0)

= -3687.5\*(1.01^6)-9066\*(1.01^5)-8946\*(1.01^4)-8826\*(1.01^3)-8706\*(1.01^2)-8586\*(1.01^1)+8792\*(1.01^0)

= -40606.34

Using Excel, FV = FV(1%,6,,-NPV(1%,F3:F8)-F2) = $-40606.34

Option 2

*Payment Plan 1*

FW @ 1% MARR: -3687.5(F|P,1%,6)-9066(F|P,1%,5)-8946(F|P,1%,4)-26265.5(F|P,1%,3)-9105.6(F|P,1%,2)-9105.6(F|P,1%,1)+9986.4(F|P,1%,0)

= -3687.5\*(1.01^6)-9066\*(1.01^5)-8946\*(1.01^4)-26265.5\*(1.01^3)-9105.6\*(1.01^2)-9105.6\*(1.01^1)+9986.4\*(1.01^0)

= $-59884.9518

Using Excel, FV= $-59885.58

*Payment Plan 2*

FW @ 1% MARR: -3687.5(F|P,1%,6)-9066(F|P,1%,5)-8946(F|P,1%,4)+1354.5(F|P,1%,3)-15924.3(F|P,1%,2)-15924.3(F|P,1%,1)-9924.27(F|P,1%,0)

= -3687.5\*(1.01^6)-9066\*(1.01^5)-8946\*(1.01^4)+1354.5\*(1.01^3)-15924.3\*(1.01^2)-15924.3\*(1.01^1)-9924.24\*(1.01^0)

= $-65153.76

Using Excel, FV= $-65180.76

*Payment Plan 3*

FW @ 1% MARR: -3687.5(F|P,1%,6)-9066(F|P,1%,5)-8946(F|P,1%,4)+1354.5(F|P,1%,3)-15924.3(F|P,1%,2)-15924.3(F|P,1%,1)-9924.27(F|P,1%,0)

= -3687.5\*(1.01^6)-9066\*(1.01^5)-8946\*(1.01^4)+1354.5\*(1.01^3)-18742.8\*(1.01^2)-18742.8\*(1.01^1)+349.2\*(1.01^0)

= $-60629.0997

Using Excel, FV= $-60629.10

Option 3

*Payment Plan 1*

FW @ 1% MARR: -3687.5(F|P,1%,6)-9066(F|P,1%,5)-8946(F|P,1%,4)-34252.4(F|P,1%,3)-5917.56(F|P,1%,2)-5917.56(F|P,1%,1)+27795.44(F|P,1%,0)

= -3687.5\*(1.01^6)-9066\*(1.01^5)-8946\*(1.01^4)-34252.4\*(1.01^3)-5917.56\*(1.01^2)-5917.56\*(1.01^1)+27795.44\*(1.01^0)

= $-43663.8123

Using Excel, FV= $-43663.81

*Payment Plan 2*

FW @ 1% MARR: -3687.5(F|P,1%,6)-9066(F|P,1%,5)-8946(F|P,1%,4)+2542.63(F|P,1%,3)-13178.7(F|P,1%,2)-13178.7(F|P,1%,1)-7178.67(F|P,1%,0)

= -3687.5\*(1.01^6)-9066\*(1.01^5)-8946\*(1.01^4)+2542.63\*(1.01^3)-13178.7\*(1.01^2)-13178.7\*(1.01^1)-7178.67\*(1.01^0)

= $-55218.944

Using Excel, FV= $-55218.94

*Payment Plan 3*

FW @ 1% MARR: -3687.5(F|P,1%,6)-9066(F|P,1%,5)-8946(F|P,1%,4)+3237.63(F|P,1%,3)-18997.6(F|P,1%,2)-18997.6(F|P,1%,1)+14715.44(F|P,1%,0)

= -3687.5\*(1.01^6)-9066\*(1.01^5)-8946\*(1.01^4)+3237.63\*(1.01^3)-18997.6\*(1.01^2)-18997.6\*(1.01^1)+14715.44\*(1.01^0)

= $-44671.504

Using Excel, FV= $-44671.50

**Annual Worth**

Option 1

We find Annual Worth using PMT function

AW1 @ 1% MARR = PMT(1%,6,-D11,-E14) = -$13200.99

Option 2

*Payment Plan 1*

AW @ 1% MARR = PMT(1%,6,-E12,-E14) = -$19468.80

*Payment Plan 2*

AW @ 1% MARR = PMT(1%,6,-D11,-D13) = -$21181.28

*Payment Plan 3*

AW @ 1% MARR = PMT(1%,6,-D12,-D14) = -$19710.32

Option 3

*Payment Plan 1*

AW @ 1% MARR = PMT(1%,6,-E10,-E12) = -$14194.96

*Payment Plan 2*

AW @ 1% MARR = PMT(1%,6,-E11,-E13) = -$17951.50

*Payment Plan 3*

AW @ 1% MARR = PMT(1%,6,-E12,-E14) = -$13886.29

**Cash Flow Comparison**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | PW | PV | FW | AW | | Option 1 | ($38,253.01) | ($34,565.51) | ($40,606.34) | ($13,200.99) | | Option 2, PP1 | ($56,414.33) | ($52,727.43) | ($59,884.95) | ($19,468.40) | | Option 2, PP2 | ($61,377.79) | ($57,715.73) | ($65,153.76) | ($21,181.28) | | Option 2, PP3 | ($57,115.35) | ($53,427.85) | ($60,629.10) | ($19,710.32) | | Option 3, PP1 | ($41,133.29) | ($37,445.79) | ($43,663.81) | ($14,194.96) | | Option 3, PP2 | ($52,018.74) | ($48,331.24) | ($55,218.94) | ($17,951.50) | | Option 3, PP3 | ($42,082.58) | ($38,395.08) | ($55,468.73) | ($13,886.29) | |  |  |  |  |
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\*red color indicates negative values

We can clearly see that the option to buy a newer version of the car (Option 1) has much higher PW, FW and AW than the first option which is to retain the car. Hence option 2 can be eliminated from consideration. Option 3 has 2 possibilities because Option 3 Payment plan 2 which is to lease the car has a very high PW, FW and AW. For comparing Option 1, Option 3 PP1 and Option 3 PP3 we can use incremental cash flows.

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | CF(O1) | CF(O3PP1) | CF(O3PP3) | CF1-31 | CF1-33 | | -3687.5 | -3687.5 | -3687.5 | 0 | 0 | | -9066 | -9066 | -9066 | 0 | 0 | | -8946 | -8946 | -8946 | 0 | 0 | | -8826 | -34252.4 | 3237.63 | 25426.4 | -12063.63 | | -8706 | -6261.6 | -19341.6 | -2444.4 | 10635.6 | | -8586 | -6381.6 | -19461.6 | -2204.4 | 10875.6 | | 8792 | 27211.4 | 14131.4 | -18419.4 | -5339.4 | |  |  | PW | $2,880.27 | $3,829.57 | |  |  | FW | $3,057.47 | $4,065.16 | |  |  | AW | $993.97 | $1,321.57 | |  |  |  |  |
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| We can see that option 1 is still the most economically viable. |  |  |  |  |
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**Summary**

* Through Financial analysis the Option to retain the car being used is the best option. This is because most of the car’s depreciation occurs in its first year of use after which there is slow but steady depreciation over its age. This means the car sold in year 3 or year 6 will have comparable Salvage value. For our impala the predicted depreciation over the next 3 years is around $4000. We would be losing money if we sold the car now compared to 3 years later. That money has more value than the economic benefits of the two alternatives.
* Option 3, Payment plan 1 is the most economically viable alternative. It only has slightly lower PW at -$41,133.29, FW at -$43,663.81 and AW at -$14194.96. Payment Plan 3 has higher AW at -$13886.98 but has lower PW at -$40,760.32 and FW at -$43,267.91. This discrepancy is because Payment Plan 1 has a much higher initial investment.
* Option 1 has PW at -$38,253.01, FW at -$40,606.30 and AW at -$13,200.99
* It is worth considering Option 3 Payment Plan 1 because it only has slightly lower PW, AW and FW values but has the added advantage of acquiring an electric vehicle which is environmentally responsible and it is also expected that the focus of the automobile market will shift towards Electric vehicles in the next few years.
* The fuel cost for the Electric vehicle is estimated using standard cost of electricity in the United States. However, most cities provide free electricity to charge electric vehicles which is an added advantage because it reduces the fuel cost to almost nothing. Additionally, most workplaces also have the facility to charge electric vehicles for free which is a very convenient option.
* Electric vehicles also have the added advantage of having much lower rates of depreciation over conventional vehicles. Our Tesla model 3 is projected to depreciate by 10.23% every year compared to the Impala which depreciates at 15.35% per year. Out of the combined 46% over 3 years, the Impala loses 37.03% of its value during the first year of its use.
* If we consider a longer planning horizon, the Electric vehicle becomes the more economically efficient option because it depreciates slower and has lower Operational and Maintenance cost. But our analysis would be pointless for longer planning horizons.
* Leasing the vehicle is not an option because we don’t get any salvage value at the end of the lease period. It is better in our case to fully purchase at the beginning or finance the purchase from a lender.
* Tesla offers an APR of 2.99% on money borrowed to purchase a Tesla vehicle. This would be the preferred option if we had a higher personal MARR. Because our MARR is just about 1%, it is better to pay the entire cost upfront because inflation would decrease our purchasing power the next year due to our low MARR.

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