Customer Lifetime Value II

This module covers the concepts of CLV, CLV Remaining, retention rate, attrition rate, discount rate, churn rate, and customer acquisition and related costs.

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Marketing Metrics Reference: Chapter 5

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Just like we use NPV to evaluate investments and companies, we use CLV to evaluate customer relationships.

CLV is the expected NPV of the cash flows from a customer relationship.

Definition
The CLV of a customer is defined as the discounted sum of all future customer revenue streams minus product and servicing costs and remarketing costs. Sometimes this is also called “customer equity”.
Our first example is a general one in which we make assumptions about the behavior of a cohort of 100 new diaper customers (as of period 0). Each of these periods represents two months of customer purchase activity. In period zero, average spending is $40 (small diapers). Over time we lose customers to others brands, but revenue per customer goes up along with the weight of the children. After 8 periods (16 months) none of the customers are still buying.
### Calculating the NPV of the Cohort

<table>
<thead>
<tr>
<th>Period (2 months)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Buying</td>
<td>100</td>
<td>50</td>
<td>45</td>
<td>40</td>
<td>36</td>
<td>34</td>
<td>32</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Avg. Rev. per Cust.</td>
<td>$40</td>
<td>$50</td>
<td>$70</td>
<td>$80</td>
<td>$100</td>
<td>$120</td>
<td>$120</td>
<td>$100</td>
<td>$70</td>
</tr>
<tr>
<td>Percent Margin</td>
<td>40%</td>
<td>40%</td>
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<td>40%</td>
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</tr>
<tr>
<td>Total Cash Flow</td>
<td>$1,600</td>
<td>$1,000</td>
<td>$1,260</td>
<td>$1,280</td>
<td>$1,440</td>
<td>$1,632</td>
<td>$1,536</td>
<td>$600</td>
<td>$140</td>
</tr>
</tbody>
</table>

\[
\text{NPV} = \$1,600 + \text{NPV (.02, } \$1,000 \ldots \$140) \\
\text{NPV} = \$9,812
\]

In this we have used a discount rate of 2% (.02) for each two-month period. The initial cash flow is now and not discounted. The formula above is what you will find in Excel for calculating NPV. The projected value of this cohort of 100 new customers is $9,812.
Calculating the CLV

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NPV = $9,812 for 100 customers.
CLV = $9,812/100 = $98.12.

This method of estimating CLV is the “cohort and incubate method.” We start with a group of like customers acquired at the same time and track their future cash flows. Clearly this is an average. Note, also, there are no remarketing costs in this example.
In the first example we illustrated CLV with projected cash flows from a cohort of like customers.

In other situations it is possible to build a mathematical model of CLV based on a set of simplifying assumptions about future customer behavior.

We set out now to describe perhaps the simplest of all CLV models:

The simple model is one in which the first time the customer does not purchase, the customer is considered “lost for good.” Thus the model better applies to contract-based services such as telephone long distance, ISPs, pest control, and magazines. It does not apply to catalog firms, however, where customers purchase intermittently. Also, if some of our diaper customers purchased in period 2, not in 3, and returned to our brand in period 4, the simple model would not apply.
Modeling CLV: A Simple CLV Model

Definition

CLV = \([M - R] \times \frac{(1 + d)}{(1 + d - r)}\)

ASSUMPTIONS:

| \(M\)  | Contribution per period from active customers. Contribution = Sales Price – Variable Costs*  
<table>
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<tbody>
<tr>
<td></td>
<td>*be careful not to double count variable costs of retention spending if they have been included below in (R)</td>
</tr>
<tr>
<td>(R)</td>
<td>Retention spending per period per active customer.</td>
</tr>
<tr>
<td>(r)</td>
<td>retention rate (fraction of current customers retained each period)</td>
</tr>
<tr>
<td>(d)</td>
<td>discount rate per period</td>
</tr>
</tbody>
</table>
A Simple CLV Model

With a little algebra, someone came up with a formula for the NPV of these expected cash flows.

\[ \text{CLV} = [\$M - \$R] \times \frac{(1+d)}{(1+d-r)} \]

This situation is simple enough that a FORMULA for the NPV of these cash flows is obtainable. The NPV of the cash flows is the CLV of the customer relationship.

This formula applies to a situation in which the company estimates the value of a newly acquired customer. This value might be used to limit the cost of acquiring a new customer.
Two Variations on the CLV Formula

1. The value of customers we anticipate acquiring and from whom we will receive an initial margin at the beginning of the customer relationship. Unlike other CLV formulas you may see, this one does NOT include acquisition cost. Hence it can be used to evaluate how much one would spend to acquire these customers.

\[
CLV = (M - R) \frac{1 + d}{1 + d - r}
\]

2. The value of (a) customers that we have already acquired (but are subject to being lost before we receive another margin), (b) customers that we intend to acquire with a free trial (no initial margin and may not be retained), or (c) customers for whom the initial margin was discounted and included in the acquisition cost. It is probably not obvious, but the difference between the two is a single, foregone (M - R). We will refer to this as CLVrem (CLV remaining).

\[
CLV_{rem} = (M - R) \frac{r}{1 + d - r}
\]
1. Be sure to use equivalent periods for retention rates, margins, retention spending, and discount rates.

2. Convert annual discount rates to monthly or vice versa as needed. 
   Effective rate for period = \((1 + \text{annual rate})^{(1 / \# \text{ of periods})} – 1\)
   Monthly rate = \((1 + \text{annual rate})^{(1/12)} – 1\)
   Quarterly rate = \((1 + \text{annual rate})^{(1/4)} – 1\)
   Annual Rates = \((\text{monthly rate} + 1)^{(12)} – 1\)

3. Retention rates = 1 - attrition rates and vice versa. Note also that attrition rate is sometimes referred to as the “churn rate”.
4. If customers pay monthly and have the option of canceling each month, use a monthly model. If they have annual contracts and pay monthly, it is a little trickier – you need to use the NPV of the monthly payments in an annual model of retention.

5. Use the time period in which “retention happens” for CLV analysis. Although we can use the formulas on previous slide – to convert discount rates and retention rates from one period to another, the choice of which period to use to calculate CLV is not arbitrary.

The period used to calculate CLV must match the period over which customers decide to remain or leave. If customers can leave (and quit paying) at the end of each month, then you should use a monthly CLV calculation (converting annual retention rates and discount rates to their equivalent monthly rates, if necessary).
Hybrid Models: It will sometimes be the case that customer payments and retention spending do not match the period with which customers churn. Customers may sign annual contracts, for example, with payments made each month. In those cases, you will want to first discount the 12 monthly payments to find the annual present value equivalent for use in an annual CLV calculation. The assumption here is that each successful annual renewal obligates the customer to 12 monthly payments.

CLV with monthly customer revenue and annual retention decisions. If customers pay monthly, but have annual contracts, you will need a hybrid CLV model. Let’s try one to see how this works…

Question 1: A pest control service nets (revenues minus variable costs) $10 a month for customers who sign annual contracts. The annual discount rate is 15% and annual retention rates are 80%.

What is the $CLV_{rem}$?
Answer

This is tricky as payments are made on a monthly basis, but retention is on an annual basis (annual contract). So, we need to use the hybrid model to solve this problem. First, convert the annual discount rate to monthly to use to determine the value of the yearly contract.

Monthly Rate  = (1 + .15) ^ (1/12) -1 = 1.1715%

Next, calculate the present value a 1 year contract (12 $10 payments)

PVm  = NPV(.011715,$10…..$10) = $111.34*

*Note: Presumes end of month payments

Finally, plug in the CLV$_{rem}$ formula:

CLV$_{rem}$  = [$M – $R] x r / (1 + d - r)

CLV$_{rem}$  = $111.34 * .8 / (1 + .15 -.8) = $254.49
Here is a numerical example that will help you check your understanding of the simple CLV model:

**Question 2:** An Internet Service Provider charges $19.95 per month. Variable costs are about $1.50 per account per month. With marketing spending of $6 per year, their attrition is only 0.5% per month.

At a monthly discount rate of 1%, what is the CLV of a customer we intend to acquire?

**Answer:** First, find the values for M, R, and r, d on a monthly basis.

\[
\begin{align*}
M &= 19.95 - 1.50 = 18.45 \\
R &= 6/12 = 0.50 \\
r &= 0.995 \\
d &= 0.01
\end{align*}
\]
Answer (Continued)

\[
\text{CLV} = \left( \$18.45 - \$0.5 \right) \times \left( \frac{1.01}{1.01 - 0.995} \right)
\]

\[
\text{CLV} = \left( \$17.95 \right) \times [67.333]
\]

\[
\text{CLV} = \$1,209
\]

The resulting figure of $1,209 is composed of two terms: the net contribution per period of $17.95 and a multiplier of 67.3.

This multiplier is a function of the retention rate and the discount rate. The high retention rate produced this high multiplier of 67.3 leading to the relatively high CLV of $1,209.

While the ISP only makes $17.95 per period, the discounted value of the expected “annuity” of these payments total 67.3 times the per period amount.

**Question 2b:** If the firm cuts retention spending from $6 to $3 per year, they expect attrition will go up to 1% per month. Should they do it?
To decide, we need to recalculate CLV under these new assumptions. If the new CLV is higher, we should do it. Otherwise, we should not. While there are others ways to analyze this proposed change, one simple way would be to simply recalculate CLV for the new situation and compare it to the “base case”.

Here is the CLV problem with the assumptions restated to fit the new situation.

**Question 2b:** An Internet Service Provider charges $19.95 per month. Variable costs are about $1.50 per account per month. With marketing spending of $3 per year, their attrition will be 1% per month. At a monthly discount rate of 1%, what is the CLV of a customer?
Answer (with the new assumption)

\[
M = \$19.95 - \$1.50 = \$18.45
\]

\[
R = \frac{\$3}{12} = \$0.25
\]

\[
r = 0.99
\]

\[
d = 0.01
\]

\[
CLV = (M - R) \times \frac{1 + d}{1 + d - r}
\]

\[
CLV = (\$18.45 - \$0.25) \times \frac{1.01}{1.01 - 0.99}
\]

\[
CLV = \$18.2 \times 50.5
\]

\[
CLV = \$919
\]

Completing the calculation shows that the new CLV would be $919. The new CLV is LOWER. The savings in retention spending is NOT worth the increased attrition. The firm should stick with the $6 retention spending. Since $919 is LESS than $1,209, the proposed change is not attractive.

Note: For comparison purposes, you could have used either CLV or CLV\textsubscript{rem} formula to make the decision.
Question 3: Company A’s Web site charges a subscription fee of $19.95 per month. The sum of variable and retention costs is about $10.00 per account per month. If the CLV of each newly acquired customer is $200, what must be the monthly customer retention rate?

Assume a monthly discount rate of 1% and a constant renewal rate.

Instead of algebra, you can use a spreadsheet to solve this problem.
In this case, we will get (almost) the same answer using the CLV_{rem} formula for current customers. Try it and see what the difference is!

Answer

So, here we’ll want to solve for retention (r) instead of CLV, since CLV is given.

\[
\begin{align*}
\$M - \$R &= \$19.95 - \$10.00 \\
\$M - \$R &= \$9.95 \\
d &= 0.01 \\
CLV &= \$200 \\
r &= ? \\
\text{CLV} &= [\$M - \$R] \times (1 + d) / (1 + d - r) \\
1 + d - r &= [\$M - \$R] \times ((1 + d) / \text{CLV}) \\
1.01 - r &= [\$9.95] \times [1.01] / \$200 \\
1.01 - r &= 0.05 \\
r &= 1.01 - 0.05 \\
r &= .96
\end{align*}
\]
Alternative Answer using CLVrem

So, now we’ll use the CLVrem equation to solve for retention (r).

$M - R = $19.95 - $10.00
$M - R = $9.95
\( d = 0.01 \)
\( CLV = $200 \)
\( r \) = ?

CLVrem = \( [M - R] \times \frac{r}{1 + d - r} \)
1+d-r = \( [M - R] \times \frac{r}{CLVrem} \)

1.01-r = 9.95 x \( \frac{r}{200} \)
202–200r = 9.95r
209.95r = 202
r = 202 / 209.95

r = \( .962 \) rounds to .96

(so, a slightly higher retention rate, significant at 3 decimal places)
Question 4: A wine-of-the-month club estimates that the CLV of their average current customer is $250.

If their annual attrition rate is 0.36 and their monthly retention spending equals $5 per customer, what must be the monthly dollar contribution per customer?

Assume a monthly discount rate of 1% and a constant renewal rate.
Answer

So, here we’ll want to solve for margin ($M$), and we’ll also want to convert the annual attrition rate to a monthly retention rate.

$M = ?$

$R = $5

d = 0.01

CLV = $250

$r = (1 - 0.36)^{(1/12)} = 0.963$  (conversion of attrition rate)

CLVrem = \[M - R\] \times \left[\frac{r}{1 + d - r}\right]

$M = R + CLVrem \times \left[\frac{1 + d - r}{r}\right]

$M = 5 + 250 \times \left[\frac{(1.01-0.963)/(0.963)}\right]

$M = 5 + 12.20

$M = 17.20 = \text{Contribution per customer}$

In this instance you would have gotten a slightly different answer if you had used the formula for newly acquired customer.
Further Reference

Marketing Metrics by Farris, Bendle, Pfeifer and Reibstein, 2nd edition, chapter 5.


- And -

MBTN CLV I Module which provides a conceptual introduction to CLV as well as some generalized problems that don’t fall into the cohort and incubate or NPV methods.