Contents

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Lifetime duration

- Average lifetime duration = $\sum_{t=1}^{T}(t * \text{Number of retained customers in } t) / N$
  - where: N = cohort size, t = time period, T = time horizon
- Limitations: information is not always complete making the calculation more challenging
  - Differentiate between complete and incomplete information on customer
    - Complete information = customer's first and last purchases are assumed to be known
    - Incomplete information = either the time of first purchase, or the time of the last purchase or both are unknown

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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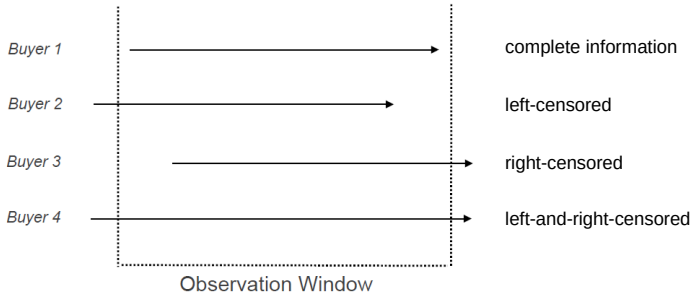
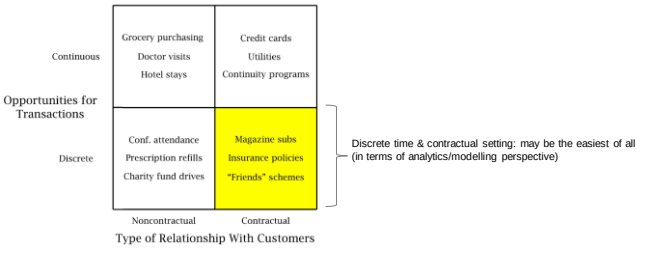
Customer lifetime duration when the information is incomplete



Lifetime duration

- Customer relationships
  - Contractual ("lost-for-good") = Lifetime duration spans from the **beginning** until the **end** of the relationship (e.g.: mobile phone contract)
  - Noncontractual ("always-a-share") = Whether a customer is **active at a given point** in time (e.g.: department store purchase)
  - One-off purchases = One time purchases (i.e. Luxury goods)



SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

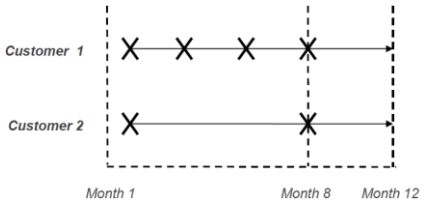
Contents

P(Active)

- Probability of a customer being active in time t
- P(Active) = τ^n
  - Where: n = the number of purchases in a given period,
    τ= is the time of the last purchase (expressed as a fraction of the observation period)
- Non-contractual case

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

Estimation of P(Active) example



An x indicates that a purchase was made by a customer in that month

- To compute the P(Active) of each of the two customers in the 12th month of activity
  - Customer 1: $\tau_1 = (8/12) = 0.6667$ and $n_1 = 4$
    $P(\text{Active})^4 = (0.6667)^4 = 0.197$
  - Customer 2: $\tau_2 = (8/12) = 0.6667$ and $n_2 = 2$
    $P(\text{Active})^2 = (0.6667)^2 = 0.444$

Comprehensive example of customer activity measures

Actual retention pattern of a direct marketing firm

1.Period since acquisition	2.Actual Retention rate	3.Predicted Retention rate	4.Defection rate%	5.Survival Rate	6.Expected Number of active customers	7.Number of Active periods
1	32.0%					
2	49.1%					
3	63.2%					
4	69.0%					
5	72.6%					
6	76.7%					
7	77.9%					
8	78.5%					
9	79.0%					
10	80.0%					
11						
12						
13						
14						
15						

?

?

Cohort of 7500 customers at the outset.

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Size of wallet

- Size of Wallet ($) of customer *i* in a category = $\sum_{j=1}^{J} S_{ij}$
  - Where: *i* = a particular customer,
    j = firm,
    J = all firms offering products in the considered category,
    S_{ij} = sales value (in category) to customer i by firm *j, j = 1,…,J*
- Information source
  - Primary market research
- Evaluation
  - Critical measure for **customer-centric organizations** based on the assumption that a large wallet size indicates more revenues and profits (health, education etc.)
- Example
  - A consumer spends on average $400 on groceries in different supermarkets per month. Thus his/her size of wallet is $400.

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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Share of category requirement (SCR)

- aSCR is defined as the proportion of category volume accounted for by a brand or focal firm within its base of buyers.
- This metric is often computed as an aggregate level metric, when individual purchase data are unavailable.

- aSCR (%) of firm (or brand) j_0 in a category $=[\sum_{i=1}^{I} S_{ij_0} / \sum_{i=1}^{I} \sum_{j=1}^{J} S_{ij}] * 100$

  - Where: j_0 = focal firm or brand,
    i = customer,
    I = all customers of firm j_0 buying in a focal category,
    J= all firms or brands available in focal category,
    S_{ij} = purchase volume of customer *i* from firm (or brand) *j*

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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Share of category requirement (aSCR)

- Example
  - Calculation of aSCR – purchases during a 3-month period
    - Brand SAMA has a MS of 33% (i.e., 8 purchases out of a total of 24) and an aSCR of 42.1% (i.e., 8 purchases out of 19, made by its two buyers)
    - This shows that even though SAMA's MS is already substantial, its aSCR is even higher

	Brand SAMA	Brand SOMO	Brand SUMU	Total
Customer 1	2	8	0	10
Customer 2	6	0	3	9
Customer 3	0	4	1	5
Total	8	12	4	24

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 14

Individual Share of category requirement (iSCR)

- iSCR (%) of customer i_0 that a firm (or brand) j_0 satisfies = $S_{i_0 j_0} / \sum_{j=1}^{J} S_{i_0 j} * 100$
  - Where: j_0 = focal firm or brand,
    i_0 = focal customer,
    J = all firms or brands available in focal category,
    S_{ij} = purchase volume of customer *i* from firm (or brand) *j*

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 15

Individual Share of category requirement (iSCR)

- Example: Individual SCR-ratios
  - Customer 3 has the highest iSCR
  - PEAR Computers should identify high iSCR customers such as customer 3, and target more of its marketing efforts (mailers, advertisements etc.) towards such customers and their respective requirements
  - Also, customer 3's size of wallet (column A), is the largest

	A Total requirement of notebook computers per customer in 2010	B Total number of notebook Computers purchased from PEAR Computers per customer in 2010	B/A Share of category requirement for PEAR computers per customer in 2010
Customer 1	100	20	0.20
Customer 2	1000	200	0.20
Customer 3	2000	500	0.25

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

Share of category requirement (SCR)

- Information source
  - Numerator: volumetric sales of the focal firm from internal records
  - Denominator: total volumetric purchases of the focal firm's buyer base – through market and distribution panels, or primary market research (surveys) and extrapolated to the entire buyer base
- Evaluation
  - Accepted measure of customer loyalty for FMCG categories
  - **SCR controls for the total volume of segments / individuals category requirements**
  - Does not indicate if a high iSCR customer will generate substantial revenues or profits
    → Can only be achieved by knowing the customer's size of wallet

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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Share of wallet

- Individual Share of Wallet (iSW)
- iSW (%) of firm j_0 to customer i $= S_{ij_0} / \sum_{j=1}^{J} S_{ij} * 100$
  - Where: j = firm,
    i = customer,
    S_{ij} = sales of firm j to customer i,
    J = all firms who offer the category under consideration
- Example
  - If a consumer spends $400 monthly on groceries, $300 thereof are spend at the supermarket “BINGO”
  - Consequently “BINGO”’s iSW for this particular consumer amounts 75%

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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Share of wallet

- Aggregate Share of Wallet (aSW) (brand or firm level)
- aSW (%) of firm j_0 = $\sum_{i=1}^{I} S_{ij_0}$ / $\sum_{i=1}^{I}\sum_{j=1}^{J} S_{ij} * 100$
  - Where: j = firm,
    i = customer,
    S_{ij} = sales of firm j to customer i,
    J = all firms who offer the category under consideration,
    I = all customers of focal firm j_0
- Example
  - The aSW is "BINGO"'s sales (value) in period t ($ 750,000) divided by the total grocery expenditures of "BINGO"'s customers in the same period ($1,250,000)
    →750,000/1,250,000 = 60%

Share of wallet

- Information source
  - Numerator: From internal records
  - Denominator: Through market and distribution panels, or primary market research (surveys) and extrapolated to the entire buyer base
- Evaluation
  - Important measure of **customer loyalty**
  - The iSW sheds light on how important the firm is for an **individual customer** in terms of his expenditures in the category
  - The aSW indicates how important (value wise) a specific firm is for its **customer base** in terms of their expenditures in the category

Application of Share of Wallet and Size of Wallet

- Share of wallet **and** size of wallet **simultaneously** – with same share of wallet, different attractiveness as customers

Example:

	Share of wallet	Size of wallet	Absolute expenses with firm
Buyer 1	50%	$400	$200
Buyer 2	50%	$50	$25

- Absolute attractiveness of Buyer 1 is eight times higher even though the SW is the same as for Buyer 2

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 22

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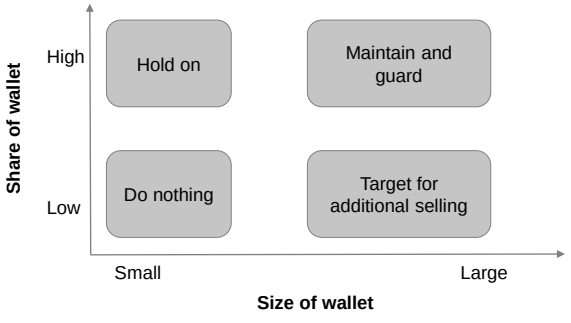
Segmenting customers along share of wallet and size of wallet



- The matrix shows that the **recommended strategies** for various segments **differ substantively**
- The firm makes optimal resource allocation decisions only by **segmenting customers along the two dimensions simultaneously**

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 23

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Share of wallet and market share (MS)

- MS of firm j_0 (%) = $\sum_{i=1}^{I}$ (iSW of customer i to firm j_0*Size of Wallet of customer i)/ $\sum_{i=1}^{I}\sum_{j=1}^{J} S_{ij}$
  - Where: j = firm,
    i = customer,
    S_{ij} = sales of firm j to customer i,
    J = all firms who offer the category under consideration,
    I = all customers
- Difference of share of wallet to market share: MS is calculated **across buyers and non-buyers**, whereas SW is calculated only among **actual buyers**

Share of wallet and market share (MS)

Example

- The supermarket "BINGO" has 5,000 customers with an average expense of $150 at "BINGO" per month (SW*size of wallet)
- The total grocery sales in "BINGO"'s trade area are $5,000,000 per month
- "BINGO"'s market share is (5,000 * $150) / $5,000,000 = 15%
- Implication: although "BINGO" has an overall low MS, it has a high SW for those consumers buying "BINGO" (assuming size of wallet per customer is $400)
  → "BINGO" is a niche player with very **loyal customers**

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Transition matrix

		Brand purchased next time		
		A	B	C
Brand currently purchased	A	70%	20%	10%
	B	10%	80%	10%
	C	25%	15%	60%

- Characterizes a customer's likelihood to buy over time or a brand's likelihood to be bought
- Example
  - The probability that a consumer of Brand A will switch to Brand B and then come back to Brand A in the next two purchase occasions is 20%*10% = 2%
- If, on average a customer purchases twice per period, the two purchases could be composed as: AA, AB, AC, BA, BB, BC, CA, CB, or CC
- It is possible to compute the **probability of each of these outcomes** if the brand that the customer bought last is known

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

Transition Matrix A Markov Chain Approach: Brand Switching Example

Suppose there exists only two cola brands in the entire cola industry.

Given that a person last purchased cola 1, there is a 90% chance that her next purchase will be cola 1.

Given that a person last purchased cola 2, there is an 80% chance that her next purchase will be cola 2.

Suppose you would like to answer the following questions:

1. If a person is currently a cola 2 purchaser, what is the probability that she will purchase cola 1 two purchases from now?
2. If a person is currently a cola 1 purchaser, what is the probability that she will purchase cola 1 three purchases from now?

Example: Brand switching (ctd.)

We view each person's purchases as a Markov chain with the state at any given time being the type of cola the person last purchased.

Hence, each person's cola purchases may be represented by a two-state Markov chain, where

- State 1 = person has last purchased cola 1
- State 2 = person has last purchased cola 2

If we define $\mathbf{X}_n$ to be the type of cola purchased by a person on her nth future cola purchase, then $\mathbf{X}_0$, $\mathbf{X}_1$, … may be described as the Markov chain with the following transition matrix:

Example: Brand switching (ctd.)

$$P = \begin{matrix} \\ Cola\,1 \\ Cola\,2 \end{matrix} \begin{matrix} \begin{matrix} Cola\,1 & Cola\,2 \end{matrix} \\ \begin{bmatrix} .90 & .10 \\ .20 & .80 \end{bmatrix} \end{matrix}$$

We can now answer questions 1 and 2.

1. We seek $P(\mathbf{X}_2 = 1 | \mathbf{X}_0 = 2) = P_{21}(2)$ = element 21 of P^2:

$$P^2 = \begin{bmatrix} .90 & .10 \\ .20 & .80 \end{bmatrix} \begin{bmatrix} .90 & .10 \\ .20 & .80 \end{bmatrix} = \begin{bmatrix} .83 & .17 \\ .34 & .66 \end{bmatrix}$$

Hence, $P_{21}(2) = .34$. This means that the probability is .34 that two purchases in the future a cola 2 drinker will purchase cola 1

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Example: Brand switching (ctd.)

2. We seek $P_{11}(3)$ = element 11 of P^3

$$P^3 = P(P^2) = \begin{bmatrix} .90 & .10 \\ .20 & .80 \end{bmatrix} \begin{bmatrix} .83 & .17 \\ .34 & .66 \end{bmatrix} = \begin{bmatrix} .781 & .219 \\ .438 & .562 \end{bmatrix}$$

Therefore, $P_{11}(3) = .781$

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Example: Brand switching (ctd.)

- Many times we do not know the state of the Markov chain at time 0. Then we can determine the probability that the system is in state *i* at time *n* by using the following reasoning.
- Probability of being in state *j* at time *n*

$$= \sum_{i=1}^{i=s} q_i P_{ij}(n)$$

where **q**=[q_1, q_2, … q_3].

Example: Brand switching (ctd.)

Suppose 60% of all people now drink cola 1, and 40% now drink cola 2. Three purchases from now, what fraction of all purchasers will be drinking cola 1?

$$P^3 = \begin{bmatrix} .781 & .219 \\ .438 & .562 \end{bmatrix}$$

$$[.60 \quad .40] \begin{bmatrix} .781 \\ .438 \end{bmatrix} = .6438$$

Example: Brand switching (ctd.)

To illustrate the behavior of the *n*-step transition probabilities for large values of *n*, several of the *n*-step transition probabilities are listed below:

n	$P_{11}(n)$	$P_{12}(n)$	$P_{21}(n)$	$P_{22}(n)$
1	.90	.10	.20	.80
2	.83	.17	.34	.66
3	.78	.22	.44	.56
4	.75	.25	.51	.49
5	.72	.28	.56	.44
10	.68	.32	.65	.35
20	.67	.33	.67	.33
30	.67	.33	.67	.33
40	.67	.33	.67	.33

This means that for large *n,* no matter what the initial state, there is a .67 chance that a person will be a cola 1 purchaser.

Steady-State Probabilities

- Steady-state probabilities are used to describe the long-run behavior of a Markov chain.
- **Theorem 1:** Let *P* be the transition matrix for an *s*-state ergodic chain. Then there exists a vector

- $\pi = [\pi_1\ \pi_2\ \ldots\ \pi_s]$ such that

$$\lim_{n\to\infty} P^n = \begin{bmatrix} \pi_1 & \pi_2 & \cdots & \pi_s \\ \pi_1 & \pi_2 & \cdots & \pi_s \\ \vdots & \vdots & & \vdots \\ \pi_1 & \pi_2 & \cdots & \pi_s \end{bmatrix}$$

Steady-State Probabilities

- Theorem 1 tells us that for any initial state *i*,

$$\lim_{n\to\infty} P_{ij}(n) = \pi_j$$

- The vector $\pi = [\pi_1\ \pi_2\ \ldots\ \pi_s]$ is often called the **steady-state distribution**, or **equilibrium distribution**, for the Markov chain.

Steady-State Probabilities

- The behavior of a Markov chain before the steady state is reached is often call **transient** (or short-run) **behavior**.
- An intuitive interpretation can be given to the steady-state probability equations.

$$\pi_j(1-p_{jj}) = \sum_{k\neq j} \pi_k p_{kj}$$

$$\pi_j = \sum_{k} \pi_k p_{kj}$$

$$\pi = \pi P$$

- This equation may be viewed as saying that in the steady-state, the "flow" of probability into each state must equal the flow of probability out of each state.

Steady-State Probabilities

- Calculate steady state probabilities for the following transition matrix:

$$P = \begin{bmatrix} .90 & .10 \\ .20 & .80 \end{bmatrix}$$

- Solution:

$$[\pi_1 \quad \pi_2] = [\pi_1 \quad \pi_2] \begin{bmatrix} .90 & .10 \\ .20 & .80 \end{bmatrix}$$

$$\pi_1 = .90\pi_1 + .20\pi_2$$
$$\pi_2 = .10\pi_1 + .80\pi_2$$

$$\pi_1 = .90\pi_1 + .20\pi_2$$
$$1 = \pi_1 + \pi_2$$

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Example: Brand Switching (ctd.)

- In the brand switch example, suppose that each customer makes a purchase of cola during any week.
- Suppose there are 100 million cola customers.
- One selling unit of cola costs the company $1 to produce and is sold for $2.
- For $500 million/year, an advertising firm guarantees to decrease from 10% to 5% the fraction of cola 1 customers who switch after a purchase.
- Should the company that makes cola 1 hire the firm?

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Example: Brand Switching (ctd.)

- At present, a fraction $\pi_1 = ⅔$ of all purchases are cola 1 purchases.
- Each purchase of cola 1 earns the company a $1 profit. We can calculate the annual profit as $3,466,666,667.
- The advertising firm is offering to change the *P* matrix to

$$P_1 = \begin{bmatrix} .95 & .05 \\ .20 & .80 \end{bmatrix}$$

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Example: Brand Switching (ctd.)

- For *P*1, the steady-state equations become
  $\pi_1 = .95\pi_1 + .20\pi_2$
  $\pi_2 = .05\pi_1 + .80\pi_2$
- Replacing the second equation by $\pi_1 + \pi_2 = 1$ and solving, we obtain $\pi_1 = .8$ and $\pi_2 = .2$.
- Now the cola 1 company's annual profit will be $3,660,000,000.
- Hence, the cola 1 company should hire the ad agency.

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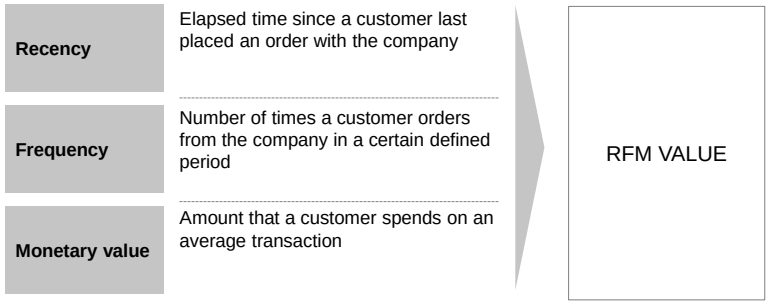
RFM method



- Technique to **evaluate customer behavior** and **customer value**
- Often used in practice
- Tracks customer behavior over time in a state-space

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

RFM method

Example

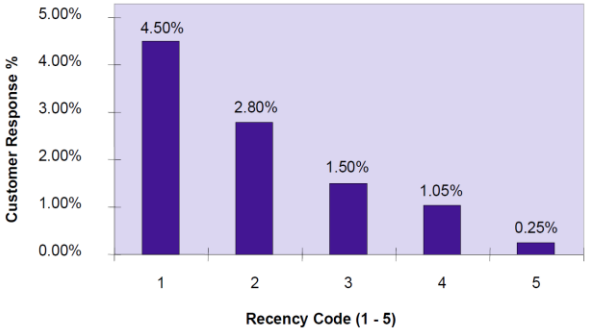
- Customer base: 400,000 customers
- Sample size: 40,000 customers
- Firm's marketing mailer campaign: $150 discount coupon
- Response rate: 808 customers (2.02%)
- Cost of mail: $1
- Profit upon coupon usage: $45

RFM method

Recency coding

- Test group of 40,000 customers is sorted in descending order based on the criterion of 'most recent purchase date'
- The earliest purchasers are listed on the top and the oldest are listed at the bottom
- The sorted data is divided into five equally sized groups (20% in each group)
- The top-most group is assigned a recency code of 1, the next group
- a code of 2 until the bottom-most group is assigned a code of 5
- Analysis of customer response data shows that the mailer campaign got the highest response from those customers grouped in recency code 1 followed by those in code 2 etc.

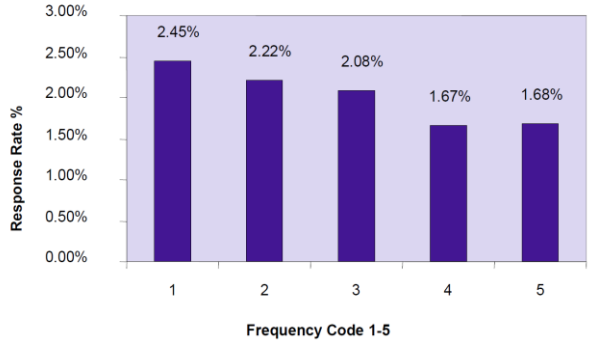
RFM method: Response and recency



- Graph depicts the distribution of relative frequencies of customer groups assigned to recency codes 1 to 5
- Highest response rate (4.5%) for the campaign was from customers in the test group who belonged to the highest recency quintile (recency code =1)

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

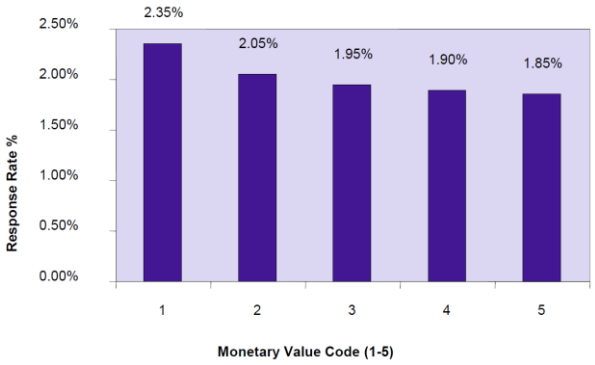
RFM method: Response and frequency



- Graph depicts the response rate of each of the frequency-based sorted quintiles
- The highest response rate (2.45%) for the campaign was from customers in the test group belonging to the highest frequency quintile (frequency code =1)

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

RFM method: Response and monetary value



- Customer data is sorted, grouped and coded with a value from 1-5
- The highest response rate (2.35%) for the campaign was from those customers in the test group who belonged to the highest monetary value quintile (monetary value code =1)

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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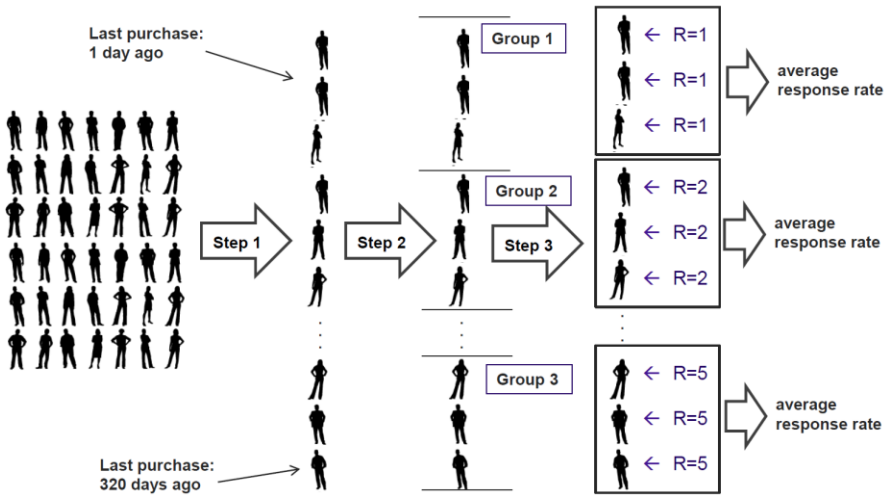
RFM method: RFM procedure



SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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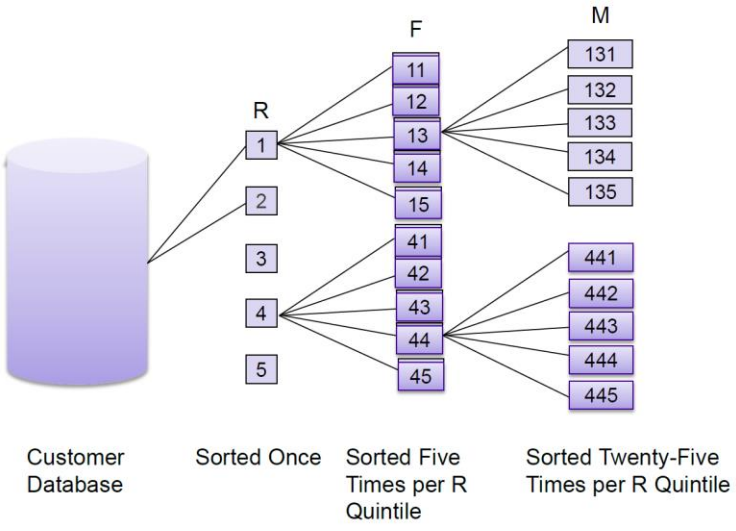
RFM method: Limitations

- RFM method 1 independently links **customer response** data with **R, F and M values** and then **groups customers** belonging to specific RFM codes
- May not produce equal number of customers under each RFM cell since individual metrics R, F, and M are likely to be somewhat correlated
  - For example, a person spending above average (high M) is also likely to spend more frequently (high F)
- For practical purposes, it is desirable to have exactly the **same number of individuals** in each RFM cell

RFM method: Cell sorting technique

- A list of 40,000 test group of customers is first sorted for recency and then grouped into 5 **groups** of 8,000 customers each
- The 8,000 customers in each group are **sorted based on frequency** and divided into five **equal groups** of 1,600 customers each - at the end of this stage, there will be RF codes starting from 11 to 55 with each group including 1,600 customers
- In the last stage, each of the RF groups is further sorted based on **monetary value** and divided into five **equal groups** of 320 customers each
  - RFM codes starting from 111 to 555 each including 320 customers
- Considering each RFM code as a cell, there will be 125 cells (5 recency divisions * 5 frequency divisions * 5 monetary value divisions = 125 RFM Codes)

RFM method: RFM cell sorting



SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 52

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RFM method: Breakeven value (BE)

- Breakeven = net profit from a marketing promotion equals the cost associated with conducting the promotion
- Breakeven Value (BE) (*for the campaign*) = unit cost price / unit net profit
- BE computes the minimum response rates required in order to offset the promotional costs involved and thereby not incur any losses
- Example
  - Mailing $150 discount coupons
  - The cost per mailing piece is $1.00
  - The net profit (after all costs) per used coupon is $45,
    →Breakeven Value (BE) = $1.00/$45 = 0.0222 or 2.22%

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 53

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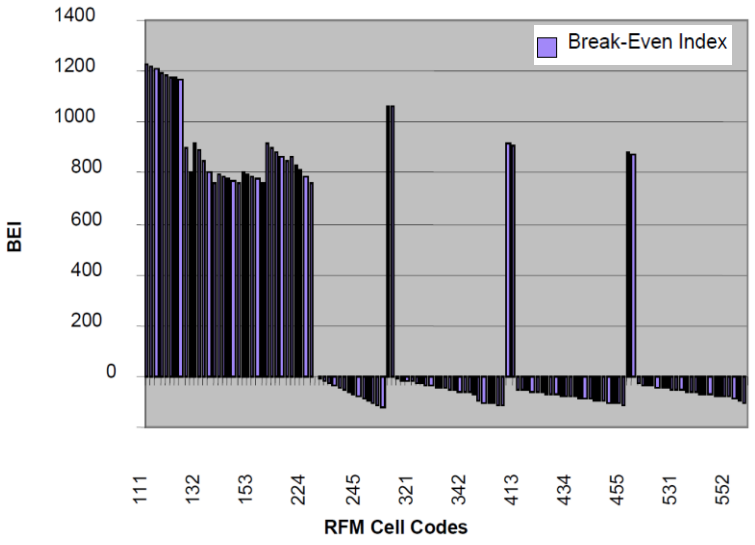
RFM method: Breakeven index

- Breakeven Index (BEI) = ((Actual response rate – BE) / BE)*100
- Example
  - If the actual response rate of a particular RFM cell was 3.5%
  - BE is 2.22%,
    → The BEI = ((3.5% - 2.22%)/2.22%) * 100 = 57.66
- Positive BEI value → some profit was made from the group of customers
- 0 BEI value → the transactions just broke even
- Negative BEI value → the transactions resulted in a loss

RFM method: Combining RFM codes, breakeven codes, breakeven index

Cell #	RFM codes	Cost per mail $	Net profit per sale ($)	Breakeven (%)	Actual response (%)	Breakeven index
1	111	1	45.00	2.22	17.55	690
2	112	1	45.00	2.22	17.45	685
3	113	1	45.00	2.22	17.35	681
4	114	1	45.00	2.22	17.25	676
5	115	1	45.00	2.22	17.15	672
6	121	1	45.00	2.22	17.05	667
7	122	1	45.00	2.22	16.95	663
8	123	1	45.00	2.22	16.85	658
9	124	1	45.00	2.22	16.75	654
10	125	1	45.00	2.22	16.65	649
11	131	1	45.00	2.22	16.55	645
12	132	1	45.00	2.22	16.45	640
13	133	1	45.00	2.22	16.35	636
14	134	1	45.00	2.22	16.25	631
15	135	1	45.00	2.22	16.15	627
16	141	1	45.00	2.22	16.05	622
17	142	1	45.00	2.22	15.95	618
18	143	1	45.00	2.22	15.85	613
19	144	1	45.00	2.22	15.75	609
20	145	1	45.00	2.22	15.65	604
21	151	1	45.00	2.22	15.55	600
22	152	1	45.00	2.22	15.45	595
23	153	1	45.00	2.22	15.35	591
24	154	1	45.00	2.22	15.25	586
25	155	1	45.00	2.22	15.15	582
26	211	1	45.00	2.22	15.65	604
27	212	1	45.00	2.22	15.55	600
28	213	1	45.00	2.22	15.45	595
29	214	1	45.00	2.22	15.35	591
30	215	1	45.00	2.22	15.25	586
31	221	1	45.00	2.22	15.15	582
32	222	1	45.00	2.22	15.05	577
33	223	1	45.00	2.22	14.95	573
34	224	1	45.00	2.22	14.85	568
35	225	1	45.00	2.22	14.75	564

RFM codes versus BEI



SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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RFM and BEI

- Customers with **higher RFM values** tend to have **higher BEI values**
- Customers with a **lower recency value** but relatively **highF and M values** tend to have **positive BEI values**
- Customer response rate drops more rapidly for the **recency metric**
- Customer response rate for the **frequency metric** drops more rapidly than the one for the **monetary value metric**

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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Comparison of profits for targeting campaign test

	Test	Full customer base	RFM
Average response rate	2.02%	2.02%	15.25%
# of responses	808	8080	2732.8
Average Net profit/Sale	$45	$45	$45
Net Revenue	$36,360	$363,600	$122,976
# of Mailers sent	40,000	400,000	17,920
Cost per mailer	$1.00	$1.00	$1.00
Mailing cost	$40,000.00	$400,000.00	$17,920.00
Profits	(-$3,640.00)	(-$36,400.00)	$105,056.00

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 58

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Relative Importance of R, F, and M

Several techniques to determine relative weights of R,F and M values:

- Regression techniques to compute the relative weights of the R, F, and M metrics
- Relative weights are used to compute the cumulative points of each customer
- The pre-computed weights for R, F and M, based on a test sample are used to assign RFM scores to each customer
- The higher the computed score, the more likely the customer will be profitable in future
- This method is flexible and can be tailored to each business situation

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 59

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Recency score

- 20 if within past 2 months, 10 if within past 4 months, 5 if within past 6 months, 3 if within past 9 months, 1 if within past 12 months, relative weight = 5

	Purchase number	Recency (month)	Assigned points	Weighted points
John	1	2	20	100
	2	4	10	50
	3	9	3	15
Smith	1	6	5	25
Mags	1	2	20	100
	2	4	10	50
	3	6	5	25
	4	9	3	15

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

Frequency score

- Points for Frequency: 3 points for each purchase within 12 months; Maximum = 15 points; Relative weight = 2

	Purchase number	Frequency	Assigned points	Weighted points
John	1	1	3	6
	2	1	3	6
	3	1	3	6
Smith	1	2	6	12
Mags	1	1	3	6
	2	1	3	6
	3	2	6	12
	4	1	3	6

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

Monetary value score

- Monetary Value: 10 percent of the $-value of purchase with 12 months; Maximum = 25 points; Relative weight = 3

	Purchase number	Value of purchase ($)	Assigned points	Weighted points
John	1	40	4	12
	2	120	12	36
	3	60	6	18
Smith	1	400	25	75
Mags	1	90	9	27
	2	70	7	21
	3	80	8	24
	4	40	4	12

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 62

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Cumulative points

- Cumulative scores: 249 for John, 112 for Smith and 308 for Mags, indicates a potential preference for Mags
- John seems to be a good prospect, but mailing to Smith might be a misdirected marketing effort

	Purchase number	Total weighted points	Cumulative points
John	1	118	118
	2	92	210
	3	39	249
Smith	1	112	112
Mags	1	133	133
	2	77	210
	3	61	271
	4	37	308

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 63

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Contents

- Traditional marketing metrics
- Customer acquisition metrics
- Customer activity metrics
- Popular customer-based value metrics
- Strategic customer-based value metrics
  - RFM value
  - Past customer value
  - Lifetime value metrics
  - Customer equity

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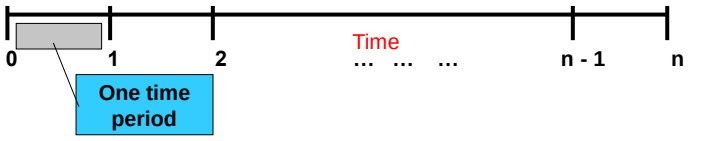
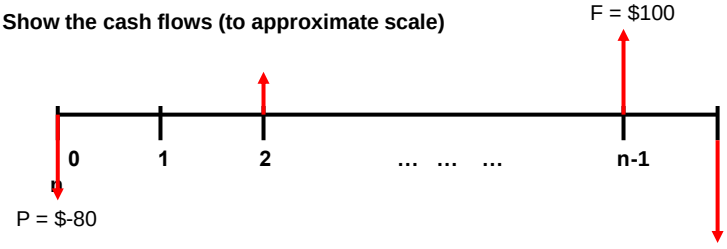
Cash Flow Diagrams

Draw a time line

Always assume end-of-period cash flows



Show the cash flows (to approximate scale)



Cash flows are shown as directed arrows: + (up) for inflow

- (down) for outflow

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Time Value of Money

TVM explains the change in the amount of money over time for funds owed by or owned by a corporation (or individual)

- Corporate investments are expected to earn a return
- Investment involves money
- Money has a 'time value'

- Simple vs Compound Interest (*discuss*)

Inflation: Increase in amount of money needed to purchase same amount of goods or services. Inflation results in a *decrease in purchasing power, i.e., one unit of money buys less goods or services*

Deflation: Opposite of inflation; purchasing power of money is *greater* in future than at present. Deflation mostly occurs at the sector level.

How to handle deflation in calculations?

Is deflation good and inflation bad? **(link)**

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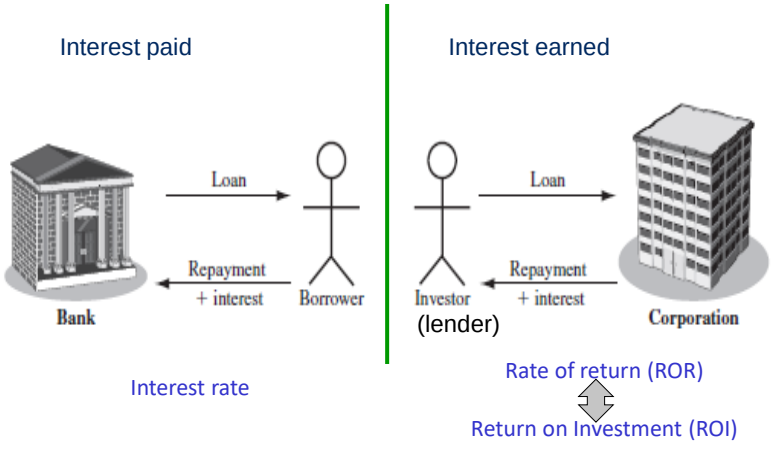
TVM- Point of View



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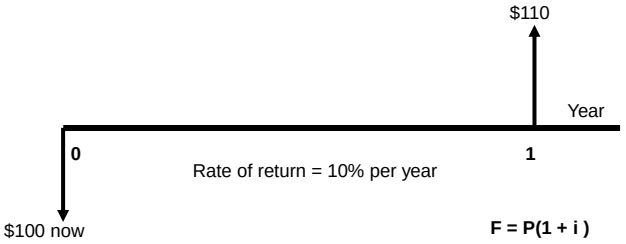
Economic Equivalence

Definition: Combination of interest rate (rate of return) and time value of money to determine different amounts of money at different points in time that are economically equivalent

How it works: Use rate *i* and time *t* in upcoming relations to move money between time points *t* = 0, 1, …, n to make them equivalent (not equal) at the rate *i*. *This is called discounting*.

Different sums of money at different times may be equal in economic value at a given rate



$100 now is economically equivalent to $110 one year from now, if the $100 is invested at a rate of 10% per year.

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Economic Equivalence – Net Present Worth (Value) - NPV

NPV:

- Discount (i.e. «carry») all cash flows to present time using designated interest rate
- Precede *costs* by *minus* sign; *receipts* by *plus* sign

- Annual worth, future worth are also common economic analysis techniques
- Note: Discuss the following
  - Rate of return (internal rate of return)
  - Payback period

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Economic Equivalence: Example

Assume a company is selling an expensive electronic device to its customers for $5000. Analyze the following repayment plans over a 5-year period:

- Customer pays all at the end of the 5 years
- Customer pays only interest annually, principal is repaid at the end
- Cusotmer pays interest & prinicipal (as equal installments) each year
- Customer pays equal annual amount (interest + a portion of principal)

Discuss: Which repayment plan should the company prefer?

Economic Equivalence: Example

(1) End of Year	(2) Interest Owed for Year	(3) Total Owed at End of Year	(4) End-of-Year Payment	(5) Total Owed After Payment
Plan 1: Pay All at End				
0				$5000.00
1	$400.00	$5400.00	—	5400.00
2	432.00	5832.00	—	5832.00
3	466.56	6298.56	—	6298.56
4	503.88	6802.44	—	6802.44
5	544.20	7346.64	$−7346.64	
Total			$−7346.64	
Plan 2: Pay Interest Annually; Principal Repaid at End				
0				$5000.00
1	$400.00	$5400.00	$−400.00	5000.00
2	400.00	5400.00	−400.00	5000.00
3	400.00	5400.00	−400.00	5000.00
4	400.00	5400.00	−400.00	5000.00
5	400.00	5400.00	−5400.00	
Total			$−7000.00	
Plan 3: Pay Interest and Portion of Principal Annually				
0				$5000.00
1	$400.00	$5400.00	$−1400.00	4000.00
2	320.00	4320.00	−1320.00	3000.00
3	240.00	3240.00	−1240.00	2000.00
4	160.00	2160.00	−1160.00	1000.00
5	80.00	1080.00	−1080.00	
Total			$−6200.00	
Plan 4: Pay Equal Annual Amount of Interest and Principal				
0				$5000.00
1	$400.00	$5400.00	$−1252.28	4147.72
2	331.82	4479.54	−1252.28	3227.25
3	258.18	3485.43	−1252.28	2233.15
4	178.65	2411.80	−1252.28	1159.52
5	92.76	1252.28	−1252.28	
Total			$−6261.40	

Equivalent to the simple interest case

Past customer value

- Computation of Customer Profitability (PCV)
- PCV of customer i = $\sum_{t=0}^{T} GC_{i(t_0-t)} * (1+\delta)^t$
  Where: i = number representing the customer,
  t = time index,
  δ= applicable discount rate (for example 1.25% per month),
  t_0 = current time period,
  T = number of time periods prior to current period that should be considered,
  GC_{it} = gross contribution of transaction of customer in period t
- Since products / services are bought at different points in time during the customer's lifetime, all transactions have to be adjusted for the time value of money
- Limitations
  - Equation does not consider whether a customer is going to be **active in the future** and it does not incorporate the **expected cost of maintaining** the customer in the future

Spending pattern of a customer

	Jan	Feb	March	April	May
Purchase amount ($)	800	50	50	30	20
GC	240	15	15	9	6

Gross contribution (GC) = purchase amount X contribution margin

- PCVi = $6*(1+0.0125)^0 + 9*(1+0.0125)^1 + 15*(1+0.0125)^2 + 15*(1+0.0125)^3 + 240*(1+0.0125)^4$ = 302.01486
- The customer is worth $302.01 expressed in net present value in May dollars
- Comparing the PCV of a set of customers leads to a **prioritization** of directing future marketing efforts

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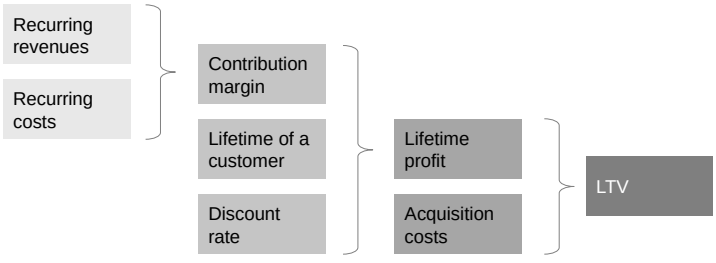
Lifetime value metrics

- Multi-period evaluation of a customer's value to the firm
- Lifetime Value (LTV)



SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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Basic LTV model

$LTV_i = \sum_{t=1}^{T} GC_{it} \left(\frac{1}{1+\delta}\right)^t$

Where: i = customer,
t = time period,
δ = interest (or discount) rate,
GC_{it}= gross contribution of customer i at time t,
T = observation time horizon,
LTV_i= lifetime value of an individual customer i at net present value time t=0

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 76

Basic LTV model

- LTV is a measure of a **single customer's worth** to the firm
- Used for pedagogical and conceptual purposes
- Information source
  - CM and T from managerial judgment or from actual purchase data
  - The interest rate, a function of a firm's cost of capital, can be obtained from financial accounting
- Evaluation
  - Typically based on past customer behavior and may have limited diagnostic value for future decision-making

Caution:
If the time unit is different from a yearly basis, the interest rate δ needs to be adjusted accordingly

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 77

LTV with splitted revenues and costs

$LTV_i = \sum_{t=1}^{T}((S_{it} - DC_{it}) - MC_{it})\left(\frac{1}{1+\delta}\right)^t$

Where: i = customer,
t = time period,
δ = interest (or discount) rate,
T = observation time horizon,
S_{it}= sales value to customer i at time t,
DC_{it}= direct costs of products by customer i at time t,
MC_{it}= marketing costs directed at customer i at time t,
LTV_i= lifetime value of an individual customer i at net present value time t=0

- The cost element of this example is broken down into **direct product-related** costs and **marketing costs**
- Depending on data availability, it can be enhanced by including service-related cost, delivery cost, or other relevant cost elements

LTV including customer retention probabilities

$LTV_i = ((\sum_{t=1}^{T}(\prod_{k=1}^{t} Rr_k)GC_{it}\left(\frac{1}{1+\delta}\right)^t)) - AC_i$

Where: i = customer,
t = time period,
δ = interest (or discount) rate,
T = observation time horizon,
Rr_t= average retention rate at time t (it is possible to use an individual level retention probability Rr_{it} but usually this is difficult to obtain),
GC_{it}= gross contribution of customer i at time t,
AC_{it}= costs of acquiring customer i (acquisition costs)

In this equation the term $\prod_{k=1}^{t} Rr_k$ is actually the survival rate SR_t

The retention rate is constant over time and thus the expression can be simplified using the identity: $\prod_{k=1}^{t} Rr_k = (Rr)^t$

LTV with constant retention rate and gross contribution

- Assuming that T → ∞ and that the retention rate and the contribution margin (CM) do not vary over time: $LTV_i = GC_i \left(\frac{Rr}{1-Rr+\delta}\right) - ACi$
- The margin multiplier: $\left(\frac{Rr}{1-Rr+\delta}\right)$
- How long is the Lifetime Duration?
  - For all practical purposes, the lifetime duration is a **longer-term duration** used managerially
  - It is important to make an educated **judgment** regarding a sensible duration horizon in the context of making decisions
- Incorporating externalities in the LTV
  - The value a customer provides to a firm does **not** only consist of the **revenue stream** that results from purchases of goods and services
  - Product rating websites, weblogs and the passing on of personal opinions about a product or brand co-contribute substantially to the lifetime value of a customer
  - These activities are subsumed under the term **word-of mouth** (WOM)

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 80

Measuring and incorporating word-of-mouth (WOM)

$$LTV_i = ((\sum_{t=1}^{T}(\prod_{k=1}^{K} Rr_k)(GC_{it} + n_{it}ACS_t)\left(\frac{1}{1+\delta}\right)^t)) - AC_i$$

Where: i = customer,
t = time period,
δ = interest (or discount) rate,
T = observation time horizon,
Rr_t = average retention rate at time t,
GC_{it} = gross contribution of customer i at time t,
n_{it} = number of new acquisition at time t due to referrals customer i,
ACS_t = average acquisition cost savings per customer gained through referral of customer i at time t,
AC_i = costs of acquiring customer i (acquisition costs)

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 81

Customer value matrix

		Average CRV after 1 year	
		Low	High
Average LTV after 1 year	High	Affluents	Champions
	Low	Misers	Advocates

CRV: Customer referral value

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 82

LTV

- Alternative ways to account for externalities
  - The value of a customer's referrals can be **separated from the LTV**, for example by calculating a separate customer referral value (CRV) for each customer
  - A **joined evaluation** of both metrics helps the management to select and determine how to develop its customers
- Information source
  - Information on sales, direct cost, and marketing cost come from internal company records
  - Many firms install activity-based-costing (ABC) schemes to arrive at appropriate allocations of customer and process-specific costs
- Evaluation
  - LTV (or CLV) is a forward looking metric that is appropriate for **long-term decision making**
  - It is a **flexible measure** that has to be adapted to the specific business context of an industry

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management 83

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Customer equity

- Customer equity (CE) = Sum of the LTV of all the customers of a firm $CE = \sum_{i=1}^{I} LTV_i$
- Where: i = customer,
  I = all customers of a firm (or specified customer cohort or segment),
  LTV_i = lifetime value of customer i
- Indicator of how much the **firm is worth** at a particular point in time as a result of the firm's customer management efforts
- Can be seen as a **link to the shareholder value** of a firm

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

Customer equity

- Customer Equity Share (CES): $CES_j = CE_j / \sum_{k=1}^{K} CE_k$
- Where: CE_j = customer equity of brand j,
  j = focal brand,
  K = all brands a firm offers
- Information source
  - Basically the same information as for the LTV is required
- Evaluation
  - The CE represents the value of the customer base to a company
  - The metric can be seen as an indicator for the shareholder value of a firm

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

Customer equity calculation example

1 Year from Acquis-ition	2 Sales per Customer	3. Manufa-cturer Margin	4. Manufac-turer Gross Margin	5. Mktg and Servicing Costs	6. Actual Retention Rate	7. Survival Rate	8. Expected Number of Active Customer	9 Profit per Customer per period per Manu-facturer	10. Discounted Profit per Customer per Period to Manufactu-rer	11. Total Disctd. Profits per Period to the Manufactu-rer
0	120	0.3	36	20	0.4	0.4	400	16	16	6,400
1	120	0.3	36	20	0.63	0.25	250	16	14	3,500
2	120	0.3	36	20	0.75	0.187	187	16	12	2,244
3	120	0.3	36	20	0.82	0.153	153	16	11	1,683
4	120	0.3	36	20	0.85	0.131	131	16	9	1,179
Total customer equity										**15,006**

- Starting cohort size is 1000 customers
- Interest rate is assumed as 10% per period

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

Customer equity calculation example - Corrected

Years from Acquisition	Sales per Customer	Margin pct.	Gross Margin ($)	Mktng. & Srvc. Cost	Retention Rate	Survival Rate	Exp. No. of Active Customers	Profit per Customer	Discounted Profit per Customer	Total Discounted Profit
1	120	0.3	36	20	0.4	0.40	400.00	16	14.55	5818.18
2	120	0.3	36	20	0.63	0.25	252.00	16	13.22	3332.23
3	120	0.3	36	20	0.75	0.19	189.00	16	12.02	2271.98
4	120	0.3	36	20	0.82	0.15	154.98	16	10.93	1693.65
5	120	0.3	36	20	0.85	0.13	131.73	16	9.93	1308.73
										14424.777

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Summary - 1

- In the absence of individual customer data, companies used to rely on traditional marketing metrics like **market share** and **sales growth**
- Acquisition measurement metrics detect the **customer level success** of marketing efforts to acquire new customers
- Customer activity metrics track **customer activities** after the acquisition stage
- **Lifetime duration** is a very important metric in the calculation of the customer lifetime value and is different in **contractual** and **non-contractual situations**
- Firms use different **surrogate measures** of customer value to prioritize their customers and to differentially invest in them
- Firms can use information about **size of wallet** and **share of wallet** together for the optimal allocation of resources
- **Transition matrix** measures the probability for a customer to purchase a particular brand providing the previous purchased brand is known

SOURCE: V. Kumar and W. Reinartz – Customer Relationship Management

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Summary - 2

- The higher the computed **RFM score**, the more profitable the customer is expected to be in the future
- The **PCV** is another important metric, in which the **value of a customer** is determined based on the total contribution (toward profits) provided by the customer in the past after adjusting for the time value of money
- The **LTV reflects the long-term economic** value of a customer
- The sum of the LTV of all the customers of a firm represents the **customer equity (CE)**