BLOG

Calculating Financial Returns in Peer Lending

NOTE: Please refer to this article (http://blog.lendingrobot.com/research/calculating-expected-return-of-note/) for details about calculation of the expected return at the *note* level.

Introduction

It is natural to want to measure the amount of money one makes from a financial investment such as Peer Lending. However, calculating returns in Peer Lending is not trivial. It presents unique challenges that must be addressed in order to arrive at a meaningful return that is comparable with other investment opportunities. The present article explains our method to calculate such returns and how we obtain the performance graphs shown on our website (https://www.lendingrobot.com/#/resources/performance/LC/).

We'll illustrate our calculations with four fictitious loans, detailed in this Google Spreadsheet (https://docs.google.com/spreadsheets/d/1KtUBaQrT9Wi3cvsZnXtkmOzxIODHcUycoG1uLG0O34Q/edit?usp=sharing):

Loan	Characteristics	Status	Net Payments	Total Net Paid
L1	$10,000 amount, 36 months term, 13% interest rate	Fully paid	36 times $333.57	$12,008.52

Loan	Characteristics	Status	Net Payments	Total Net Paid
L2	$7,500 amount, 36 months term, 13% interest rate	Repaid early	19 times $333.57, then full early repayment of $5,209.59 at the 20th month	$11,547.43
L3	$10,000 amount, 36 months term, 13% interest rate	Current	7 times $333.57 so far, with 29 payments remaining	???
L4	$6,000 amount, 36 months term, 17% interest rate	Defaulted	9 times $333.57, then stopped paying and defaulted	$1905.99

You will also find the calculation formulas in the aforementioned spreadsheet.

Returns Calculations

Conceptually, financial returns are easy to grasp; they show how much money was gained (or lost) compared to the initial investment. If P_1 is the sum of payments for loan L1 of amount A_1, then R_1, or the return on investment (https://en.wikipedia.org/wiki/Return_on_investment), is:

$$R_1 = \frac{P_1 - A_1}{A_1} = \frac{\$12,008.52 - \$10,000}{\$10,000} = 20.09\%$$

A return of 20.09% on a loan with a yearly interest rate of 13% may look too good to be true. In a way, that's because it is…

The beauty of the Return on Investment lies in its simplicity, but its pitfall is that it fails to take into account how much time was needed to earn the return. This is especially important in Peer Lending, where monthly payments are expected over a multi-year period.

The loan *L2* is also fully paying, but because it repaid early it accumulated less total interest. Therefore its ROI is lower:

$$R_2 = \frac{\$11,547.43 - \$10,000}{\$10,000} = 15.47\%$$

However, this makes little sense; since *L2* paid less in total but gave back the money sooner, the returns between *L1* and *L2* should be roughly comparable.

Time Value of Money

Matters become more complicated when the time value of money is taken into account. A dollar today is worth more than a dollar tomorrow, which means cash received in the future must be discounted. A future value *FV* t years in the future is worth a present value *PV*, such that

$$PV = \frac{FV_t}{(1+r)^t}$$

where *r* is the discounting rate.

Several methods have been devised to calculate time-sensitive financial returns in an attempt to balance ease of calculation with accuracy. The method viewed as the most accurate, and the one we use at LendingRobot, is called Internal Rate of Return (https://en.wikipedia.org/wiki/Internal_rate_of_return) (IRR). Calculating the IRR consists of finding the discounting value *r* so that the sum of *n* discounted, future payments *p* equals the present value *A* of the initial investment:

$$A = \sum \frac{p_t}{(1+r)^t}$$

The monthly IRR for loan L1 is *r* such that:

$$\$10,000 = \frac{\$333.57_1}{(1+r)^1} + \frac{\$333.57_2}{(1+r)^2} + \frac{\$333.57_3}{(1+r)^3} + \ldots + \frac{\$333.57_{36}}{(1+r)^{36}}$$

By iterations (there's no direct way to solve the equation above), we get *r = 0.01025*.

To obtain the annualized value *R* from the monthly IRR *r*, we calculate:

$$R = (1+r)^{12} - 1 = (1.01025)^{12} - 1 = 13.02\%$$

Predicting Future Returns

After a Peer Lending loan is issued it is supposed to generate constant monthly payments until it reaches term. A historical return analysis could look at only mature loans in order to estimate a return, but because Peer Lending is relatively new and rapidly growing, a huge proportion of the loans issued have not yet reached their term. Besides, limiting our evaluation to only these mature loans would incur at least a three-year delay in showing performance since the shortest loan durations are 36 months.

We can predict future payments by extrapolating from both historical default rates and survival curves. This enables the construction of a vector of payments combining both past cash flow events p and future cash flow events q, where the future cash flows are discounted to reflect the cumulative probabilities of default. For instance, for loan $L3$:

$$P_3 = [p_1, p_2, \ldots, p_7, q_8, \ldots, q_{35}, q_{36}] = [\$333.57, \$333.57, \ldots, \$333.57, \$332.30, \ldots, \$317.05, \$316.99]$$

A somewhat convoluted formula described in a previous paper (http://blog.lendingrobot.com/research/predicting-returns-for-ongoing-loans/) allows a loan's status and number of payments to be taken into account in order to improve that prediction's accuracy.

This allows us to calculate the 'expected return' of loans that have yet to reach maturity.

Averaging Returns

A Peer Lending portfolio is usually comprised of hundreds or thousands of different notes. The easiest way to aggregate returns is to calculate their arithmetic mean.
When evaluating a given portfolio, we can weight each loan's return by the amount invested in them before averaging. When evaluating overall market performance, we do not weight the returns by loan amounts, as an individual investor is likely to invest similar amounts of money in every loan.

It is worth noting that aggregated returns are slightly different depending on if we average the returns of individual loans or aggregate the cash-flows and then calculate the returns:

Loan	ROI	Expected Return
L1	20.09%	13.02%
L2	15.47%	12.83%
L3	16.64%	10.91%
L4	-68.23%	-91.22%
Weighted Average Returns of Loans	2.21%	-6.32%
Aggregated Cash-flows Return	2.21%	1.59%

Therefore the calculations mentioned here shall be understood as answering the question 'How much money do I make on a loan, on average?' rather than 'How much money do I make on an entire portfolio?'

Evaluating Returns over time

Determining an investment's performance over time raises the concern of defining what is meant by 'monthly return'. For any given month the easiest definition would be to calculate the lifetime return for all loans issued during that month. Examining monthy returns this way does not, however, provide an accurate picture of a portfolio's performance over time. For instance, a loan issued in July 2007 may have defaulted in May 2009 during the economic recession. Although the loan ended in default, it does not necessarily mean that the investment decision was bad at inception. To fully capture when positive (full payment) or negative (default) events occur, we need instead to average the returns of all the loans currently paying in any given month.

Simulating the Impact of Diversification

A portfolio's volatility is expected to decrease as the number of securities it contains increases, provided that the performance of each security is uncorrelated.

A Monte Carlo simulation allows us to measure the impact of diversification in Peer Lending without having to make any specific assumptions. In essence, a Monte-Carlo simulation (https://en.wikipedia.org/wiki/Monte_Carlo_method) is repeating a random experiment enough times to obtain a reliable average measure. In the present case, it consists of picking random samples of portfolios many times, then measuring the distribution of returns. Although tedious and computationally intensive, the process is commonly regarded as reliable. To estimate the range of expected performances, we simulate the returns of a portfolio of different sizes, then keep the 95% confidence interval.

LendingRobot Selection

LendingRobot's loan selection algorithm ranks loans shortly after their release. To evaluate the performance of the LendingRobot model, we average the expected returns of the top quartile of ranked loans at the time of issuance. Considering LendingRobot is expected to represent significantly less than a quarter of any given platform's investments, we view the choice of the top quartile as conservative (in other words, a more restrictive choose, such as the top 5% could show significantly higher returns).

Caveats

Although the methods described herein seem based on sound reasoning to us, no simulation or estimation is perfect. It is worth being aware of the following limitations:

- These are only back-tested results. One shall be cautious that such results are often too optimistic, as they come from a model that has been trained on similar data.
- Predictions for the probabilities of default over the life of a loan are only valid as long as the underlying data remains consistent. Said otherwise, extrapolation of past data stops being valid if there are significant changes to anything that may impact default rates (e.g. drastic changes to underwriting policies).
- Loan performances are probably not entirely uncorrelated. For instance, a nation-wide economic crisis may effect the repayments of many different loans.
- Available data is not perfect. For instance, it may be slightly outdated or missing accurate payment history information, requiring some conservative assumptions to calculate returns. Similarly, some loan data may be inconsistent and needs arbitrary fixes or must be excluded altogether.
- Averaging returns instead of aggregating cash-flows produces an exaggerated impact for defaulting loans, as shown in the four loans example above. As a consequence, newer loans appear as producing vastly improved performance, which may not necessarily be true.

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Pingback: Marketplace Lending News Roundup – November 14, 2015 - Lend Academy (http://www.lendacademy.com/marketplace-lending-news-roundup-november-14-2015/)

Roger Duncan says:　**Reply (http://blog.lendingrobot.com/research/calculating-financial-returns-in-peer-lending/?replytocom=66#respond)**

November 19, 2015 at 3:56 AM (http://blog.lendingrobot.com/research/calculating-financial-returns-in-peer-lending/#comment-66)

So my question is about the performance graph found on the website. Presumably those results are from the Lending Robot automated investment platform. But which setting? The most aggressive?

Stephen Zentner (http://blog.lendingrobot.com) says:　**Reply (http://blog.lendingrobot.com/research/calculating-financial-returns-in-peer-lending/?replytocom=67#respond)**

November 19, 2015 at 3:12 PM (http://blog.lendingrobot.com/research/calculating-financial-returns-in-peer-lending/#comment-67)

Yes, this is the unrestricted LendingRobot loan selection model. A bit about how we restrict loan grades when considering risk tolerance is available at http://blog.lendingrobot.com/product/fully-automated-mode/ (http://blog.lendingrobot.com/product/fully-automated-mode/)