

# Minimization of borrower's payments in mortgage lending

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In [1], the problem of minimizing the borrower's risks in mortgage lending was considered. The model described gives good practical guidelines for reserving funds. In this paper, we describe a model in which, in the case of a shortage of funds for the current payment, a default is not declared, as in the model from cite MS, and the borrower has additional costs. Such costs can be accounted for using short-term ancillary loans. Then there is no risk of default on the main debt, but additional loans can significantly increase the total payments that need to be minimized.

The borrower wants to buy an apartment cost  $S_0$  and he has accumulation of  $M_0$  rubles. Out of this money, a reserve of  $Z_0$  is formed. The difference between  $M_0$  and  $Z_0$  is paid as an initial contribution, and  $D = S - M + Z$  is a credit for an annuity scheme for  $T$  years at a rate  $r$ . The borrower's income at the moment of time  $t$  is a random variable  $xi(t)$  with a known distribution.

In the presence of free cash, the borrower may early repay part of the loan. If current receipts are not enough to pay off the next payment, the borrower takes an additional loan for a single period of time at a rate of  $r_B > r$ . Within the framework of this model it is we need to determine the total credit period  $T$  and the amount of reserved funds  $Z_t$ , at which the expectation of total payments on loans will be minimal.

To solve this problem, an algorithm based on the dynamic programming scheme has been developed. A program was written and an experiment was conducted, including real data. Dependencies of payments on parameters  $T$  and  $Z_0$  are constructed, the theoretical justification of the obtained results is carried out. Calculations allow us to identify the critical values of the parameters  $T$  and  $Z_0$ , at which the total payments are significantly increased.

## References

- [1] Malakh S.A., Servakh V.V. Optimization total payments and default risk of borrower in mortgage // Abstracts of the XVI Baikal International School-Seminar "Optimization methods and their applications", Irkutsk, ISEM SB RAS. P.72, (2014)