

# Insurance annuity calculator in R

## User Manual

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## 1 Introduction

This document describes the use and function of the *Annuity calculator* written in R. The program is intended to simulate 10,000 independent customers purchasing an annuities using a mortality table. An input file provided to the program will give a initial age range that will be used to randomly select a starting age, or the age that the person will purchase an annuity product. Then, the mortality table will be used to randomly select a death age based on the distribution provided by the mortality table. This can be used to calculate the amount of profit or loss for the insurance company for an individual annuity product.

## 2 Input

Three auxiliary comma-separated-value files are required to use the script: *input.csv*, *ROI\_input.csv*, and *mortality.csv*. The *input.csv* contains the following input parameters that should be provided to the script, shown in Table 1:

input_age_start	The lower bound of the age range for purchasing annuity
input_age_end	The upper bound of the age range for purchasing annuity
maturity_age	The age at which the annuity matures
monthly_annuity	The desired monthly annuity benefit
interest_rate	The interest rate
term_length	The number of terms for N-year annuities
iterations	The number of simulations to run

Table 1: Input parameter descriptions

Note that column headers `input_start_age`, `input_age_end`, etc are required for the script to function correctly. Each row of the input column will represent a single simulation. An example *input.csv* file is shown in Table 2. In this case, the program will simulate a group of 100 individuals, aged 25 to 40, purchasing a \$1000 annuity benefit that matures at age 60.

<b>input_age_start</b>	<b>input_age_end</b>	<b>maturity_age</b>	<b>monthly_annuity</b>	<b>interest_rate</b>	<b>term_length</b>	<b>iterations</b>
25	40	60	1000	0.05	20	100

Table 2: Example *input.csv* file

The *mortality.csv* file should contain two columns: an *age* column containing a list of integer ages, and a *mortality* column containing the probability of death at each age. An example *mortality.csv* file is given in Table 3.

Age	Mortality
0	0.02042
1	0.00133
2	0.00122
...	...
98	0.67499

Table 3: Example *mortality.csv* file

Finally, Table 4 shows an example *ROI\_input.csv* file. The number of rows in this file should not exceed the number of rows in the *input.csv* file. However, if the number of rows is less than the *input.csv* file, the last row of the ROI file will be used for all subsequent simulations.

<b>company_years</b>	<b>ROI_interest</b>	<b>investment_percent</b>	<b>policy_sales_goal</b>
75	0.05	0.25	100

Table 4: Example *ROI\_input.csv* file

### 3 Use

To run the program, simply use the *source* command from within RStudio, or another R interface running R version 3.5.1 or greater. It may be necessary to first set the working directory to the directory containing the *input.csv* files using either the *setwd()* command or using *Session → Set working directory → to source file location*. The program will output a report and a set of tables containing the expected profit or loss to the company based on the simulated business block. Plots and output will be placed in the *output* folder, with a single subfolder for each row in the input file.