

# Crowdworking Model

## 1 The model

The purpose of this agent-based model is to compare different variants of crowdworking in a general way, so that the obtained results are independent of specific details of the crowdworking platform. It features many adjustable parameters that can be used to calibrate the model to empirical data, but also when not calibrated it yields essential results about crowdworking in general.

### 1.1 Overview

Agents compete for contracts on a virtual crowdworking platform. Each agent is defined by various properties like qualification and income expectation. Agents that are unable to turn a profit have a chance to quit the crowdworking platform and new crowdworkers can replace them. Thus the model has features of an evolutionary process, filtering out the ill suited agents, and generating a realistic distribution of agents from an initially random one. To simulate a stable system, the amount of contracts issued per day can be set constant, as well as the number of crowdworkers. If one is interested in a dynamically changing platform, the simulation can also be initialized in a way that increases or decreases the number of crowdworkers or number of contracts over time. Thus, a large variety of scenarios can be investigated.

### 1.2 Agents

The most crucial part of such a model are of course the agents. They are defined by various properties that are distributed heterogeneously. Each agent has an individual cost of living, which measures the expenses each agent has each month. The average of this cost of living is 1000 Monetary Units (MU) with a standard deviation of 100 MU, meaning that more than 95% of the agents have a cost of living between 800 and 1200 MU. In addition each agent has also a certain qualification. Qualification defines the quality of work an agent can produce. Qualification is uniformly distributed between 0 and 10, and as such is an abstract measure of qualification and not directly related to education. A qualification value of 9.5 just means that the agent is better qualified than 95% of its competitors. Each agent has also an expected income. It is based on the average payment received for a contract of the agents qualification level, thus higher qualified agents expect a higher income. The additional payment for each level of qualification is a parameter that can be chosen freely.

Parameter	Description	Default value
workforce	The number of crowdworkers active on the platform	1000
contracts	The number of contracts issued every day	500
d-workforce	The change of the number of crowdworkers per month	0
d-contracts	The change of number of contracts issued every day per month	0
payment	The minimal payment for a one-day contract	150 MU
payment-factor	The additional payment for a one-day contract for each level of qualification	5 MU
competition	The percentage of workers with a significantly lower cost of living	0%
competition-factor	The relative reduction of cost of living and income expectation of those workers	0.5
quit-chance	The chance of a worker to quit after a month of negative profit	25%

Table 1: Adjustable parameters of the model

These agents interact with a virtual crowdworking platform. This platform is abstracted in the sense that it only contains contracts with various properties, but no individual employers, corporations or firms. All contracts have a required quality, which represents the qualification of the workers that the clients desire and an expected cost, which represent the amount of money the clients are willing to pay for this contract. The required quality is distributed uniformly between 0 and 10 to match the qualification of the workforce. The interpretation is the same, a contract with a required quality of 1.5 means that 15% of the crowdworkers will be not qualified enough for this contract. Each contract also has an expected cost, which is the average income expectation of an agent with exactly the right qualification level.

### 1.3 Adjustable parameters

Because of its abstract approach, the presented model has many parameters that can be chosen freely in order to simulate different scenarios, calibrate the model to empirical values or show that some results are independent of the specifics of those parameters. Table 1 shows all the adjustable parameters and their default values. For a detailed analysis of the impact of the most important parameters, see the section “sensitivity analysis”.

The default values were selected as follows. One MU is defined as the average cost of living divided by 1000, thus the average cost of living is 1000 MU. In order to simulate a stable crowdworking platform, in which it would in theory be possible for every worker to earn a decent living wage, 1000 workers compete for 500 contracts a day, which pay at least 150 MU, leading to a average possible profit of more than 1000 MU for each worker. For each level of qualification, the payment increases by 5 MU, so that the payment for contracts ranges from 150 MU to 200 MU, i.e. the more difficult contracts pay a third more than the simpler contracts. This value is consistent with the recommended paying rates on prominent crowdworking platforms. The chance to quit after a month of negative profit is derived from the idea that crowdworkers have to look for alternatives if their savings are depleted. Most financial advisers recommend a liquidity (i.e. the relation between savings and monthly expenses) of 2 to 6, i.e. enough savings to cover 2 to 6 months without income. With a quit chance of 25% also in the model the workers have to quit after 4 months without profits on average.