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## The steps of an experiment in experimental economics

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**Abstract.** This document applies to anybody who wants to understand what is Experimental Economics and the benefits that can profit from this approach for empirical works which validity and scope can be evaluated in a scientific work. In a pragmatic way are described in this document the different steps to be followed methodologically to set out an experiment. Our goal is to give our readers a broad view of an experimental process in economics. Further to the logistics aspects and data collection, this guide also tackles the tools used to work with data and the methodological referees that allow analysing the first results. It also reviews various animation support of the experimentalist community in France.

**Keywords :** Experimental economics, experience, methodology

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## Definition

The use of experiments has long been presented as impracticable by schools of thought presenting economics as a discipline where, like other social sciences, the validation of economic theories was based on uncontrolled observations, essentially through investigation.

However, building on the previous practices of psychometricians, experimental economics gradually came into being from the second half of the twentieth century as a scientific discipline. Experimental economics makes it possible to test economic theories by confronting them with the reality observed according to specific configurations integrating the behavior of economic agents, their social practices, and the institutional rules to which they are subject. It can also be used to test hypotheses for which there are no underlying theories.

Experimental economics was largely inspired by experimental methods developed in psychology.

Is there an experimental approach specific to economics?

Experimental economics is a scientific approach making it possible to reconstitute decision contexts by working in a controlled environment (most often, in the laboratory, but sometimes also in a natural environment) in order to artificially reproduce a situation reflecting economic theory or yet to get closer to economic reality.

We speak of an experimental protocol because an experiment requires following a rigorous process articulating research objectives prioritized according to precise rules of experimentation. These codified steps also extend to the selection of subjects who are recruited under some conditions set in advance by the experimenter.

Principle of an experimental session in economics

The principle is to invite subjects (students, consumers, producers, etc.) to act within the framework of a game defined by the experimenter. The rules of the game take the structure of the reconstructed real economic situation.

Each subject has the role of an economic agent (e.g., a buyer, a seller, etc.) whose characteristics are defined by the experimenter by preferences, technologies, monetary and information endowments. Each subject's decision in the game gives them a gain (or loss) expressed in monetary form. The basic principle is that each subject should bear the financial consequences of the choices he/she made during the experiment. As the subjects are nevertheless individuals a priori all different, the

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relevance of the economic experiment rests on the theory of induced value (Smith, 1976), which makes it possible to ensure control of the parameters tested.

Five principles must be observed in the design of an economic experiment:

*Insatiability:* A subject always prefers to have more compensation than he/she already has, which means that each subject's utility is a monotonously increasing function of their earnings.

*Prominence (or Saliency):* a subject's gains are a function, which he/she knows perfectly well, of his/her possible actions and the possible actions of the other subjects. Prominence distinguishes experimental economics from traditional investigations and simulation insofar, as it provides an incentive for subjects to act in the laboratory as they would act in the real world. The incentive amounts to saying that the subject must bear all the financial consequences of their choices.

*Dominance:* Monetary gains from experimentation explain subjects' actions better than any other factor, which means that any influence other than earnings on the subject is negligible for his/her in-game decision making.

*Secret:* the subject is the only one to know his/her own endowments and winnings during the game, even if he/she may need to know the aggregated results during the game. This guarantees his/her autonomy of choice.

*Parallelism:* this is the measurement of the difference between reality and the laboratory, in other words, the external validity of data produced in the laboratory. This condition leaves the possibility of inferring from the laboratory to the real, in other words, it makes it possible to claim that the behavioral regularities observed in the laboratory must persist in a real situation as long as the underlying conditions remain unchanged. It is arguably on this point that experimental economics meets the strongest skepticism. The argument is that large-scale economic behavior can never be reproduced on a small scale by students. One answer (Plott, 1982) is to retort that a robust theory is made to work in all cases, even in the lab, as long as the *ceteris paribus* clause (all other things being equal) is followed. If it fails in the lab, then the theory needs to be revised.

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## Why carry out an experiment?

An experiment meets three main objectives:

- compare the data collected with theoretical predictions,
- help decision-making by evaluating the impact of different factors or parameters (for example public policies public (taxes, new industrial strategies, etc), without the need to expose the population concerned to incur the costs of an effective implementation,
- produce new knowledge, when the theory is incomplete or non-existent.

## An experiment

### Scientific aspect - Preparation of the protocol

The experimental approach is particularly suitable for testing certain economic hypotheses.

In practice, the research team is involved in an experimental economics project and submits the protocol it has developed to a working group responsible for discussing and validating the experimental protocols upstream of the experiments. Once the protocol has been validated, the team relies on the framework thus defined to write the instructions that will frame the actions of all the subjects who will participate in the experiment. It is the statement of these "rules of the game" which guarantees the "controlled" framework.

### Course of the experiment:

#### Development and / or use of specific tools

The development of experiences is based on:

- classic programming languages (Python C languages, Php, Java, VB languages).
- tools dedicated to experiments such as Z-tree or Otree. These tools are used to manage the part experience, database and payment.
- internal tools developed in the laboratories of the EcoSocio department such as "LE2M" in Montpellier or even "Gael experience" in Grenoble.

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## The place

Most of the time, experimental economics sessions take place in the laboratory, but it can happen that they are held outside these structures.

Outside of a laboratory:

This scenario corresponds to experiences in the field. These sessions are implemented, depending on the conditions, either from paper supports or with laptops as well.

In laboratory :

A room is generally specifically dedicated to experimental economics sessions. It is organized around several computer stations, partitioned or not, so that each subject has an individual computer. The ideal is to use a room with twenty-four machines because this allows experiments to be carried out in groups of two, three, four, six or eight subjects (example of a room in the appendix). The subjects are usually installed in individual boxes (with instructions to follow), but in some situations (notably in field experiments), we will favor the use of a mobile laboratory, more flexible.

Another possibility is to use pencil and paper, but this technique is more complicated to manage for the retrieval, storage and chain of data processing.

Finally, still little used, new techniques are emerging, such as:

- i) "eye tracking" which makes it possible to study the reactions of gaze movements which are unconscious and precisely reflect the cognitive processes engaged in a real context of use.
- ii) sensory sensors that record heartbeats, physical reactions during decision making to know the chronology (timing) of decision making.

## Recruitment

It is carried out according to the specificity of the experience.

Initially, the experimentalists mainly recruit students through emails, advertisements in the Training and Research Units of universities or via social networks.

Recruitment can also be refined according to the profile of the subjects, their habits (consumption for example), their level of study, etc.

If you want to involve subjects that are not students, it is possible to call on specialized companies or place announcements on online sites (vivastreet).

Note: Leboncoin does not accept to post recruitment advertisements for experiments.

You can also use flyers, newspaper advertising, media advertising, local radio or television announcements, telephone recruitment ...

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Over the course of the experimental sessions, the experimentalists can build up a directory of participants allowing them to operate from a pool of subjects available according to the specificities of the experiments.

To collect the online registrations of subjects, the experimentalists use tools specially configured for the management of the experiments and the distribution of the candidates between the different sessions on the basis of criteria defined in advance by the experimenter. ORSEE ([www.orsee.org](http://www.orsee.org)) is the best known of these and the most frequently used. It has the advantage of being easy to configure to generate a website backed by a database that allows simultaneous management of the experience calendars and the recruitment database. It allows to keep the history of player participation. The articulation of these different aspects is based on the principle of "client / server" via php, SQL and MySQL.

It is important to specify that students who register in the database must first adhere to the ethical rules of laboratories.

### The organized sessions

#### - In the experimental economy room:

Each experiment is described in an experimental protocol which details its progress and the organization of the different sessions. For each of them, subjects receive an individual invitation. The subjects are welcomed in 3 stages: on their arrival, the subjects are received in a friendly space in order to put them at ease, then, they are invited to join the experimental room to participate in the experiment, finally, they are received individually by a member of the team of experimenters to receive their earnings at the end of the session.

Note: when developing the experience, a first session (called a "pilot session") is generally organized internally. It makes it possible to test and validate the experience at both organizational and technical levels. It is in particular an opportunity to test the computer program and the understanding of the interfaces, but also to discuss/possibly re-specify the scientific objective with the researchers. Depending on the case, the pilot sessions can take place with recruited subjects or simply with members of the research project.

#### - In the Conviviality Room:

First, the subjects are received in a convivial room, in order to offer them a snack to place them in the best conditions, time to make the call and discuss with them, in particular about the experimental economics room and its organization.

Some experimenters allow the subjects to visit the room to prove that all the machines are identical and that all the subjects will be placed under the same conditions.

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Then the subjects are invited to draw a random number. This number corresponds to the box number in which each participant will settle and therefore to the machine to which he will be assigned. This moment is important because it makes it possible to confirm again to the subjects that the experimental design is anonymous and the result of chance.

#### - In the Experimental Economics Room:

Each subject takes place in the box which has been allocated to him/her by drawing lots. In addition to the post he can use sheet of paper, pencil and a calculator.

Once inside the room, the subjects no longer have the right to communicate with each other or with the outside (phone, tablets off). They are therefore in a controlled environment.

At the start of each session the experimenter reads the instructions to clearly explain the course of the experiment. It is important that the experimenter read the instructions aloud to prove that all are participating in the same experiment, and are at the same level of understanding and information.

When the experiment is complicated, it is important to schedule a small, real-time start-up test, with a focused question to ensure that the subjects understand the instructions. For some experiments, one can go so far as to plan a "blank" trial so that the subjects become familiar with the screen and the interface. This is a separate test from the rest of the experiment to make sure the subjects understand the process and are familiar with the graphical environment of the experiment.

At the end of these different stages, the experience can begin.

Once the process of the experiment is complete, subjects are (almost systematically) asked to complete a questionnaire (often referred to as the "final questionnaire") which exclusively includes socio-demographic questions. The data collected then make it possible to characterize the sample and, if necessary, to qualify the interpretation of the results of the experiment by using control variables for possible selection bias.

#### - Outside the laboratory:

When the context of the study does not lend itself to the organization of a session in an experimental room, it is possible to do experiments outdoors by reconstituting an experimental economy room with a mobile laboratory or with surveys questionnaires.

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## Compensation

During an experiment in experimental economics, all subjects are compensated which is not necessarily the case in psychology:

- on the one hand, all receive fixed compensation, or not, linked to their participation as equivalent to their travel expenses.
- on the other hand, they are compensated according to the gains accumulated during the experience.

Global compensation is paid at the end of each session, but the conditions of compensation are set and defined upon registration. Students sign a receipt for participation.

The budgets allocated to the experiments come from research projects and are managed either by authorities in the universities after the establishment of agreements, or by groups of economic (GIE) or scientific (GIS) interests, created in support of the centers of research.

The fixed compensation may vary from one laboratory to another (in the order of € 2 to € 10).

Then participation evolves; the subjects are compensated on the basis of approximately € 10/hour spent for the experiment, an hourly rate charged in France. But depending on the difficulty of the experiment, the gains may be re-evaluated or devalued, or even zero if the subject has not really made the expected choices. For example in some experiments, some subjects are likely to make risky choices and lose their gain.

Whatever decisions the subjects make during an experiment, they cannot under any circumstances spend their own money (including the fixed indemnity definitively acquired).

In some laboratories, subjects are compensated in vouchers.

Note: Very often the experimenters practice overbooking during reservations in order to have as many subjects as possible. If too many people show up, those not selected by lot receive only the fixed compensation.

## Subjects

The participants in the experiments are called subjects. They have no obligation to participate in an experiment and are voluntary. They sign a participation charter.

As already said, in economics any participation in an experiment is compensated unlike in other disciplines.

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The topics are divided into different categories:

- "Mr. Everyone": when the experience does not require any constraint or skill in the choice of subjects, which is rather rare.
- Students: they represent the majority of subjects solicited during experiments for reasons of geographical proximity to the laboratories, availability during the day, and marked interest in the experiments.

Note: Student recruitments must be modulated according to their studies and their level because this can introduce bias into the results (especially for economics students). Taking part in an experiment does not influence the scores of students on exams.

- Groups: it is possible to target a group of people according to specific criteria (purchase of organic food for example).
- On the internet: through the Amazon Mechanical Turk site, it is possible to offer experiences to subjects connected at random anywhere in the world or targeted. This makes it possible to have a pool of subjects at a very low cost and available. On the other hand, the experimenter cannot control how the subjects respond. Its use still implies compliance with US law.

## The results

During the experiments, the data is stored in a database and saved for analysis after each session.

Often initially, the experimenters consult the data obtained for a first evaluation: are the data reliable and usable?

Then, using scientific software, the data is formatted, checked, then processed and analyzed using the appropriate statistical and econometric tools (eg: Matlab, Mathematica, Statistica, Stata, R, Gauss etc).

Then, depending on the quality of the data observed and the results obtained, either the hypotheses made in the experimental protocol are not verified and possibly new experiments can be organized according to modified hypotheses or a different protocol, or the hypotheses that are tested are verified and validated by experimentation. It may happen that no results are obtained.

The results obtained at the end of the experiments and the analysis of the data thus collected will, in fine, be used in the form of an article in order to disseminate the conclusions to which the study has led to the entire scientific community.

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## Laboratories

- ALISS : Alimentation et Sciences Sociales, INRAE Paris
- BEE : Laboratoire du groupe de recherche Behavioral and Experimental Economics, Toulouse School of Economics (TSE) à Toulouse
- GAEL : Laboratoire d'Economie Appliquée de Grenoble
- GATE-LAB : Laboratoire Expérimental du Groupe d'Analyse et de Théorie Economique (GATE) à Lyon
- LABEX-EM : LABORatoire d'économie EXpérimentale en Économie et Management du Centre de Recherche en Economie et Management (CREM) à Rennes
- LEEM : Laboratoire d'Économie Expérimentale du Laboratoire Montpelliérain d'Economie Théorique et Appliquée (LAMETA) à Montpellier
- LEEN : Laboratoire d'Économie Expérimentale du Groupe de Recherche en Economie, Droit, et Gestion (GREDEG) à Nice
- LEEP : Laboratoire d'Économie Expérimentale de la Paris School of Economics (PSE) à Paris
- LEES : Laboratoire d'Économie Expérimentale du BETA à Strasbourg
- LESSAC : Laboratoire d'Expérimentation en Sciences Sociales et Analyse des Comportements à l'ESC Dijon

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## Journals and associations

### Specific sites

- the Economic Science Association (ESA) website:  
<https://www.economicsscience.org/>
- the site of the French Association of Experimental Economics (ASFEE):  
<http://www.asfee.fr/>

### Specific journal

- Experimental Economics,
- Journal of Economic Behavior and Organization and Games and Economic Behavior,
- Journal of Behavioral and Experimental Economics,
- Journal of the Economic Science Association,
- Management Science,
- Journal of Economic Psychology.

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