

ARQUIMETRIA¹: The Statistics Applied to Research in Architecture

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To cite this article: BLASQUES, Francisco; SILVA, Sérgio – ARQUIMETRIA: The Statistics Applied to Research in Architecture. **Estudo Prévio** 3. Lisboa: CEACTION/UAL - Centro de Estudos de Arquitectura, Cidade e Território da Universidade Autónoma de Lisboa, 2013, p. 36-42. ISSN: 2182-4339 [Available at: www.estudoprivio.net].

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Introduction

Despite its technical dimension closely linked to construction, to metric, to the representation systems and to legitimacy, architecture is mainly distinguished by its connection to human and symbolic issues, therefore to the subjective universe. This project aims to map part of this universe, bringing together two people from different areas, in a quantitative and a statistical analysis of relevant issues in architecture.

How do you usually use your home? What do you like to have close by? What do you like to have far away? How do you like to go from one place to another? Where do you do things and where don't you like to do them? We raise all these issues when developing an architecture project. We often realize that people do not know exactly what they want. They are also too attached to images they saw and do not know why they like them. An architect's work is often that of a translator. To understand what the other truly wants and know their preferences. Enumerating and systematizing them thus becomes a need to understand and translate what people think.

The construction of mathematical models allows us to understand how people deal with certain spaces and generate forms of spatial organization, which can be translated into the design of dwellings or other buildings. This seems to be an important tool for analyzing spaces, programs, activities and other components that may be relevant for the perception of reality in architecture, as well as to help complement and correct the preconceptions we have of the world. This does not mean that we think that mathematical models can replace architects. However, we feel that mathematical analysis can inform the architect and help him decide.

Building a model on reality, whichever that instrument is, always implies its brutal simplification, choosing information over another and, in this choice, many aspects end up being left out. On the other hand, by simplifying the complexity of what is real, we gain analysis and, in a very concise and particular way, we are able to isolate some elements and study them.

Objectives of the Research Project

In this project we wanted to focus our attention on people's preferences on how organizing different activities in their homes. Mainly, by analysing the role of the rooms in the contemporary house, relating spaces to daily activities. Our goal is transforming subjective data into objective data, as well as characterizing people's preferences on how they divide the spaces. This leads us to think of something that is immaterial in architecture and which represents in a way its level zero. Therefore this research is focused on what is typically called the program of a building, in this case, of a dwelling.

Knowing that people usually do not exactly know what they want and have problems in translating it, we propose a study indicating what their preferences are. This research is based on data revealed by people at a given time, so its observation base will always be dated, so the inferences therefore withdrawn will inevitable be connected with the moment of collecting data that we are based on.

Finally, the practical goal of this project is to inform the architect's decision about the design of a dwelling, in its most functional way, which is improving the distribution of activities / functions for the several spaces.

Methodology and Some Statistical Results

The research we propose is focused on collecting processing data obtained through online surveys made to 129 people with 12 different nationalities, different ages and professions. We would also like to point out that the vast majority of the respondents reported living in an apartment in the city. These surveys seek to portray people's preferences about the organization and use of the different spaces in the house, depending on the activities. Naturally, their preferences are not in itself neither good nor bad, neither right nor wrong, that are only their preferences revealed at that precise moment.

In this survey we asked respondents to distribute a number of common activities by the different rooms of a dwelling. This choice was restricted to the number of spaces available and to the activities they could choose from. The idea is to know how people assemble a limited number of activities in different spaces. On which activities they have more affinity and which ones they reject.

The activities that fall into this study and upon which we reflect are: recreation, cooking, eating, working and sleeping. The proposed scenarios require restrictions. Initially, we asked people to distribute the five activities in a house with two spaces, i.e., two rooms. Then, with the same logic, we asked to distribute the five activities in a house with three spaces, and, finally, with five rooms². It was also asked which room people prefer to attach an outdoor space. And lastly, the size of the rooms, which one is the biggest and which is the smallest.

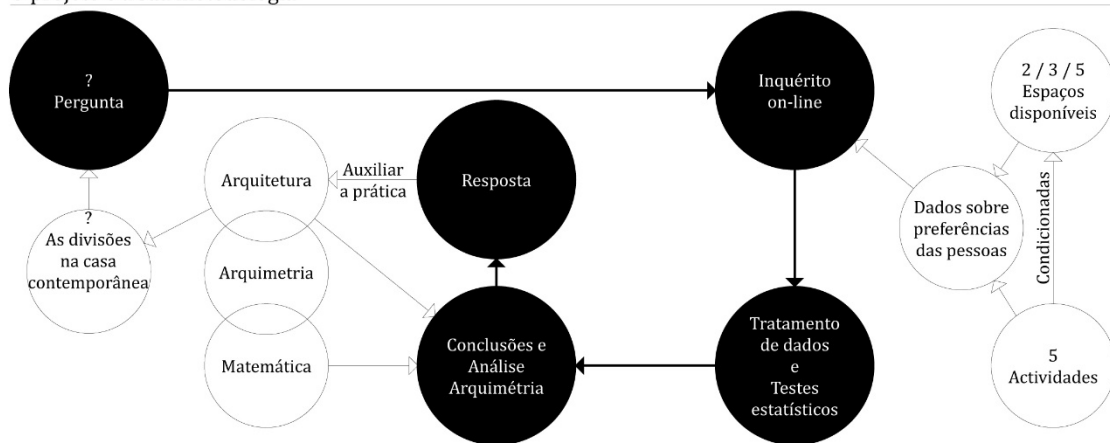
With this information it was possible to build an organizational model of the program of the dwelling, describing its relationship with the outdoor space and realizing which activities require bigger or smaller rooms. The statistical tests concluded, with varying degrees of confidence, what people's preferences are in relation to the organization of the space and the relationship among them.

Simple statistical, frequency and correlation analysis reveal, for example, a strong preference for living in a house where cooking is conducted in only one isolated room, instead of being integrated in the living room, even if, ultimately, it implies having only one room for sleeping, recreation and working.

Using a statistical analysis, of principal components, we can reduce the number of variables needed to explain the organization of the house and, interestingly, we obtained three components that we all recognize, the kitchen, to cook and eat; the living room, for recreation and work and the bedroom, to sleep³. This analysis also reveals a strong preference for living in a house with an outdoor space in the living room (for example a balcony), instead of in the kitchen or in the bedroom. We can also conclude, with a high level of confidence, that the bedroom is without a doubt the smallest room in the house.

Building models for prediction is also possible in architecture. Estimated models with the data collected allow, for instance, predicting what type of house an individual prefers, based only on some of his features. This type of analysis can, to some extent, help architects design simple or complex structures. However, this should always be complemented with another type of information, including qualitative information. Totally ignoring the empirical data or the statistical tests seems to be, at least, counterproductive.

O projeto e a sua metodologia



Practical Implications of the Results

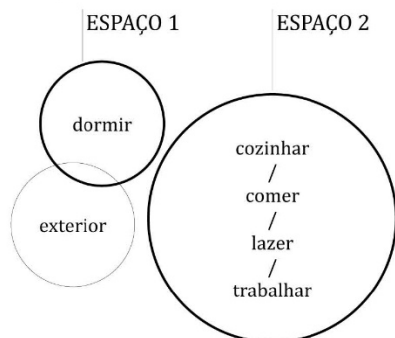
The statistical results not only have academic relevance, but also practical. For example, the data collected suggest that certain blueprints and the organization of dwellings meet more the preferences of the average consumer than others. In particular, the study shows changes to several blueprints of the house that are supported by empirical evidence. Thus, we show how statistical data can be used in a practical way in defining and organizing the program of a dwelling.

For a house with two rooms, the statistical evidence shows that the organization of the dwelling in Figure 1b is preferable to the organization adopted in Figure 1a.

Figure 1a may represent, for instance, a house with a small sleeping space connected with the outdoors and with a larger room for cooking, eating, working and recreation. Figure 1b shows the same house, with the amendments suggested by the statistical evidence in which the smallest room is for cooking and eating, and the biggest room, containing the outdoor space, is for working, sleeping and recreation.

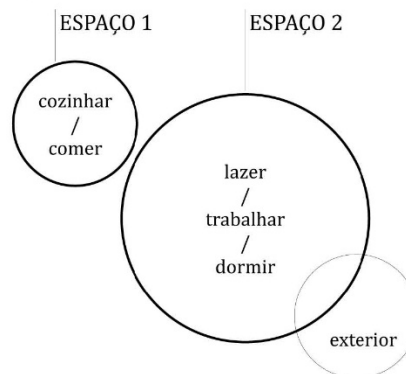
2 ESPAÇOS
Organização casa 1

Figura 1a



2 ESPAÇOS
Organização casa 1, com correcção do modelo estatístico

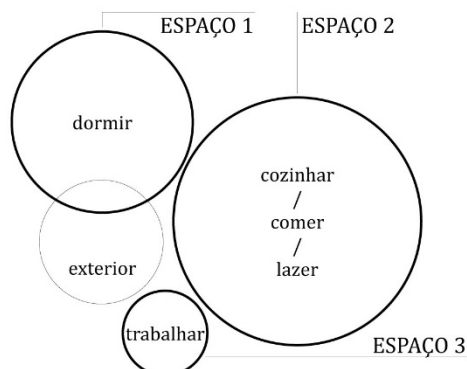
Figura 1b



This type of change can also be observed in the case of three rooms: see Figures 2a and 2b.

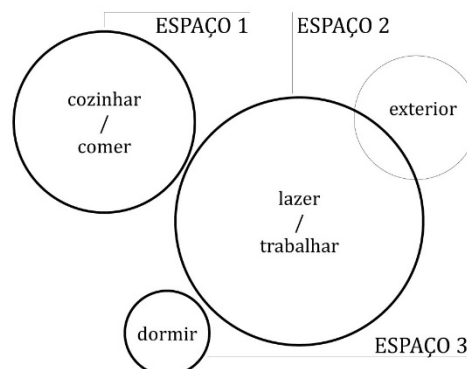
3 ESPAÇOS
Organização casa 2

Figura 2a



3 ESPAÇOS
Organização casa 2, com correcção do modelo estatístico

Figura 2b

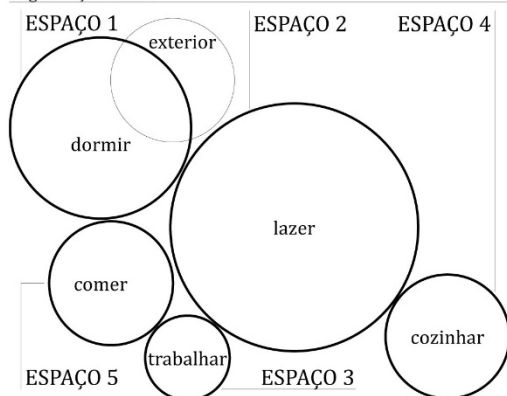


It is interesting to observe that in the case of multiple spaces (Figures 3a and 3b), it was possible to separate all the activities, and yet, the respondents preferred to continue adding some of them, generating an organization equal to the previous one in which there were five activities. Thus seems that a house for these activities does not need more than three distinct spaces. This does not mean that people prefer houses with only three rooms, but rather that if there were more rooms it would be to repeat some of these activities.

MÚLTIPLOS ESPAÇOS

Organização casa 3

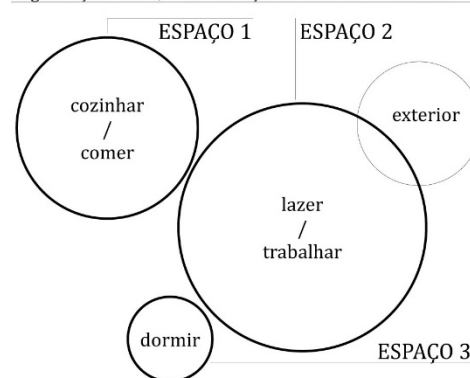
Figura 3a



MÚLTIPLOS ESPAÇOS

Organização casa 3, com correção do modelo estatístico

Figura 3b



We would like to state that the model does not intend to design the house, or assume as better or worse, it simply indicates people's preferences and creates an organization that is more likely to appeal to a greater number of people.

Conclusion

Introducing statistical analysis in architecture allows an approach to complex programs, to cross-check information and without a defined user, which is the case, among others, of an airport, or a hospital. These buildings, which are designed for everyone and no one in particular, can greatly benefit from the information that generated the statistical data. Knowing its users' preferences we can design more appropriate spaces. We understand the position related to the spaces/activities that people prefer, realizing which should be attached and which should be separated or isolated. Even when dealing with a certain client, when building their house, this instrument can be used to compile the random information that is given.

Statistical analysis also allows us to study people's preferences about, for instance, colours, light, geometrics, volume and materials. We may also know if there is a relation between the proportions of a space and the feeling of comfort, and what types of light people prefer in a certain context. Thus, the use of such instruments in architecture seems quite pertinent. With this study we hope to take the first step, even if a small one, in which architecture and statistics are brought together.

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¹ Arquimetria _ (archimetrics) is a neologism created by us, connecting two words, Architecture and Metrics. We refer to “Arquimetria” when talking about the quantitative study (mathematical and/or statistical) of architecture, such as Biometrics, Sociometry and Econometrics refer to the quantitative study of Biology, Sociology and Economy.

² With five rooms available the respondents were able to separate all the activities in different spaces.

³ The analysis of *principal components* seeks essentially to find a small number of variables that may explain almost all the data collected. For example, in this study the activities “cooking” and “eating” can be integrated into a single variable we call “cooking”.