Probability and Statistics are the Foundation for Building Your Architectural Career

Introduction

As future architects, we all dream of creating iconic buildings that result in professional recognition and financial success. Increases in 'big data' and the technologies to analyze these data sets more effectively make it possible to improve the quality of our designs in significant ways during the design process. However, to integrate these big-data benefits into our design solutions, we need to become proficient in probability and statistics while in school.

To illustrate this to you, I will describe how probability and statistics are used in architectural design and show that this skill will help start your career when you graduate. First, I will discuss the uses of probability and statistics for improving the outcomes of several phases of architectural projects. Then I will talk to you about the importance of having the skill to complete data analysis when starting your career.

The Use of Probability and Statistics in Architecture

Design Phase Use of Probability and Statistics

Architects use probability and statistics during different phases of projects to improve and evaluate the effectiveness of their built projects. In the following sections, I will present the use of probability and statistics in four project phases:

1. Architects use probability and statistics during *site selection* to analyze relevant data.
2. In *pre-design*, they analyze client needs and evaluate their client's industry space use trends.
3. During *design*, they assess the layout and material options against existing performance data.
4. In *post-occupancy*, they evaluate the performance of the space against project goals, comparable properties, and performance standards and requirements.

By integrating data-driven decisions into the design process, architects can be confident that they will achieve the high client satisfaction needed for financial success.

Probability and Statistics in Site Selection

An organization's selection of location impacts many aspects of business success. The decision may be which city to locate in, what city section to move to, or what specific property to occupy. However, for each decision, organizations must consider a wide range of business impacts that location choices can have and if these will be positive or negative for their business. With statistical and probabilistic analysis, architects can present the business impacts of many factors based on current data and predicting how many factors are likely to develop in the future. These factors include access to employees with the necessary skills, proximity to clients or customers, local cost of living and expected wages, and commute time and transportation access for employees.

Architects can use these analyses to combine client data, publicly available data, and mobile device data to make data-driven site selection decisions (Intalytic, 2021). With this, architects provide their clients with better business outcomes.

Probability and Statistics in Pre-Design

Architects collect and evaluate data statistically during the pre-design stage to determine building space needs (Vangelatos, 2018) currently and into the future. Input from client interviews and surveys, company growth projections, and industry benchmarks are all integrated into space needs and acquisition decisions. Client organizations will rely on the dependability of this work as they sign leases that extend for years or sometimes decades.

Probability and Statistics in the Design Phase

During the design phase, architects make decisions on materials and building systems so that projects meet current regulations for things such as energy and water use (Yaglewad, 2020). Additionally, we are often required to go beyond this to meet standards like the LEEDS Sustainable Buildings Certification and Zero Net Energy (Carbonnier, 2020). Our ability to run virtual simulations that statistically evaluate and present a wide range of design, material, and construction options is critical to our success in this phase. These simulations integrate physics and statistics to provide sophisticated examinations of building performance of various design choices. Findings from these simulations allow architects to make changes to improve building performance before anything is built (Goy, Maréchal, and Finn, 2020).

Post Occupancy Evaluations with Probability and Statistics

After clients move into buildings, sensors connected to the internet can measure and evaluate actual building performance (Davis, 2015). Owners can assess building performance against building code requirements and targeted certification programs, such as LEED (Davis, 2015). With the decrease in the cost of monitoring systems, building owners and occupants are using these systems to collect and evaluate data on building use and building systems performance in increasingly complex ways. Vendors of building systems components are creating sophisticated data visualizations to present this data in easy-to-understand formats.

Clients are using these analyses to move toward performance-based contracts with architects. These contracts hold back part of the design fees until clients evaluate the buildings resulting from an architect's design against required performance standards (Davis, 2015). To get the compensation they are due, architects' pre-design systems of evaluation must match the post-occupancy performance of the resulting buildings. As a result, architects now have a significant financial stake in the accuracy of the probability and statistical analyses they complete.

Probability and Statistics Literacy will Enhance Your Employability

You may think that this is a skill-set you can skip and allow others to bring to architectural firms. However, recent data from the National Association of Architecture Schools and Design Firms (NAASDF) suggests you should think again about this. In their 2020 study, NAASDF identified the skills most important for entry level employees in modern design firms as compared to skills identified in their 2010, and 2000 studies. The survey included 285 firm principles from the Architecture firms ranked in the top 50 for design per Architecture Form Magazine. This included firms as small as 200 people up to firms of over 5,000 people. The top five skills are shown on (table 1) below.

Table 1 – Most Important Skills for Recent Architecture Graduates

	2020		2010		2000	
Skills (rank)	Skills (named)	Score (mean)	Skills (named)	Score (mean)	Skills (named)	Score (mean)
1	Teamwork	6.7	Teamwork	6.6	Teamwork	6.3
2	BIM documentation	6.4	BIM documentation	6.5	CAD documentation	6.6
3	Quantitative Analysis	6.1	Communication	5.8	Materials & Methods	5.7
4	Communication	5.6	Material & Methods	5.3	Communication	5.5
5	Materials and Methods	5.3	Quantitative Analysis	4.9	Design Capability	4.5

Notes

1. The survey was completed on a 7-point Likert scale where 1is absolutely unnecessary, 2 is very unnecessary, 3 is somewhat unnecessary, 4 is neither necessary or unnecessary 5 is somewhat necessary, 6 is very necessary, and 7 is absolutely necessary

This survey indicates that the quantitative skills we develop in a probability and statistics course are increasingly important skills as design practices have changed the way services are provided in the last decade. For this reason we should all see becoming proficient in applying probability and statistics to design work as skills that will assist us in getting our first jobs.

Conclusion

This document discusses the many phases of architectural design work in which probability and statistics play a role. They are first used to evaluate different options for siting a project. Then to document building needs into the future. During the following phase of work, architects run many design choices through simulations that evaluate and present various design choices in building performance. Finally, owners use probability and statistics to collect data and analyze building performance outcomes. Clients are frequently connecting these outcomes to completing payment of architectural contracts. For this reason, as with many fields, using and evaluating data in a wide range of probability and statistics applications is a skill that employers have indicated is critical. When we prepare to graduate, we now know this is a skill we must have to start on a path of financial and professional success

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