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# A Mathematical Method to Assess the *Yin-Yang* Balance of Commercial Complexes' Entrances

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**Abstract**

Shopping malls are important landmarks of modern and sustainable cities as they are substantial business and investment by themselves, and as they also facilitate the social activities of communities. Entrances to shopping malls provide a first impression to customers, thus affecting the business performance of the malls. This paper presents a method to assess the entrances of modern shopping malls by applying traditionally qualitative *Feng shui* practices quantitatively with an innovative mathematical model. The assessment is based on the manipulation of the *yin*-and-*yang* concept applied to the layout of *Ming tang* (bright court) as the focus of consideration. By applying this novel approach to three shopping malls in Guangzhou, China as a pilot study to match their commercial performance, our hypothesis appears workable. The ideology of balancing *yin* and *yang* may be practically meaningful to urban planning and the successful measurement of such balance could shed light on future studies.

*Keywords*: *Feng shui*, shopping mall, *yin-yang* setting, *Ming tang*, mathematical model



## 1.0 INTRODUCTION

Shopping malls constitute a key component of a modern sustainable city (Ozuduru et al., 2014) as they are the places for business, investment, and social activities of the community (Sutrisno & Sastrawan, 2020). Previous research has focused on the impact of anchor stores on shopping center performances (Damian et al., 2011), the relationships of retail sales and pedestrians' accessibility (Kang, 2016), or walking and shopping behaviors of pedestrians (Hahm et al., 2019). Survey, ordinary least squares, and spatial analyses were applied in their studies. Previous studies also demonstrate that store design, such as product display, space, convenience to socializing, and parking, and store atmosphere, such as fragrance, lighting, and cleanliness, of shopping malls could impact their business performances (Nasim & Shamshir, 2018). Sutrisno and Sastrawan (2020) applied qualitative methods to study the effect of multi-entrances of shopping centers on visitor circulation. The design of the pavement immediately outside the entrance (similar to *Ming tang* in ancient China, also known as the bright court) was related to residential development (Tam et al., 1999) and architecture (Hwangbo, 2002), but there is no research has been specifically undertaken on the relationship between shopping malls' *Ming tang* and their business performances.

O'Roarty et al. (1997) suggested that a better environment of shopping centers yields higher revenues. This implies that shopping malls' entrances are attractive elements of the retail-built environment. A good design of shopping malls' entrances could attract people visiting, shopping, entertaining, or conducting social gatherings and thus improve business performances of the shopping malls. This is logical as the entrance of a shopping mall provides customers a first impression. Moreover, the design of *Ming tang* (bright court) may also affect the business performance of a shopping mall. To test this hypothesis, this paper relies on traditional *Feng shui* concepts regarding *yin-yang* interaction and a quantitative model is further developed to evaluate the *Ming tang* and business performance of shopping malls. It is believed that this research could renew the understanding of *Feng shui* and shed new light on the investigation of modern architecture and urban planning. The next section reviews the relevant terms of *Feng shui* theory. Section 3 describes a mathematical model based on some *Feng shui* practices of the Form School for assessing the *Ming tang* in front of a shopping mall's entrance. Three shopping malls in Guangzhou (capital of Guangdong province in China) are selected for this pilot case study as each of them represents the high, medium, and low levels of business performance. After applying the developed model to the three cases, we provide the findings and discuss the implications.

## 2.0 FENG SHUI THEORIES

*Feng shui*, the ancient Chinese wisdom related to architecture, planning, and built environment, has been developing for over 3,000 years. It originated from ancient people's observation of astronomical phenomena, natural phenomena, and human behavior (Feuchtwang, 1974). Though the subject of *Feng shui* was once considered non-scientific, more recently, researchers have increasingly considered its scientific elements with contributions to modern architecture and urban planning (Mak & So, 2011, 2015). The theories of *Feng shui* can be broken down into *yin* and *yang*, the world's well-known concept in traditional Chinese culture. The *Feng shui* of a place can impact its prosperity (Mak, 1998), and *Ming tang*, the empty space or pavement in front of an entrance in modern terms, for example, can be a major contributing factor. Previous studies of *Feng shui* theories and applications were mainly qualitative.

*Qi* is one of the most critical elements in *Feng shui* (Mak & So, 2011; Xu, 2003). Previous studies mostly consider *qi* as a type of energy and one translation of *qi* is "life's energy" (Lip, 2009). In *Feng shui* literature, *qi* is often quoted with a leading descriptor to convert such an abstract concept into a concrete one. *Sheng qi* and *sha qi* are the two fundamental types of *qi* in *Feng shui*. *Sheng* means growth and vividness in Chinese, and wherever there is *sheng qi*, there is a trend for positive development. In the context of shopping malls, *sheng qi* could foster business performance. *Sha* means inauspiciousness and fierceness, or killing in Chinese, and wherever there is *sha qi*, there is a trend for negative development. Noticeably, as they are both energies of different strengths, *sha qi* could somehow be turned into *sheng qi* if its strength is eased.

The concept of *sheng qi* can be understood by the mechanism of *yin* and *yang*. The balance of *yin* and *yang* produces *sheng qi* and the imbalance of *yin* and *yang* generates *sha qi*. Conceptually, in *Feng shui*, *yang* means active and *yin* presents static (Mak & So, 2011, 2015). This can also apply to physical items. Xu (1990) translated that the solid is *yin* and the void is *yang*. Based on this principle, an empty space is *yang* and occupied space is *yin* while considering the dimension of space. An empty space belongs to *yang* as it allows the free flow of things and thus constructs an active environment, while occupied space belongs to *yin* because things cannot flow freely due to the existence of occupied blocks, which is considered a still environment. However, if the content within is considered holistically, what is inside the space could affect its *yin* and *yang*. For example, a road that is occupied by moving vehicles could be *yang*. This paper focuses on the layout of shopping malls' entrances. As such, only the dimension of space is considered.

In the book *Yijing*, from which *Feng shui* theories originate, there are four aggregates of *yin* and *yang* according to their proportions, namely "*tai yin*" (greater *yin*), "*tai yang*" (greater *yang*), "*shao yin*" (lesser *yin*), and "*shao yang*" (lesser *yang*), where the former two represent *yin* or *yang* which are extremes and the latter two represent a more or less balanced *yin* and *yang* configuration, as shown in Figure 1.

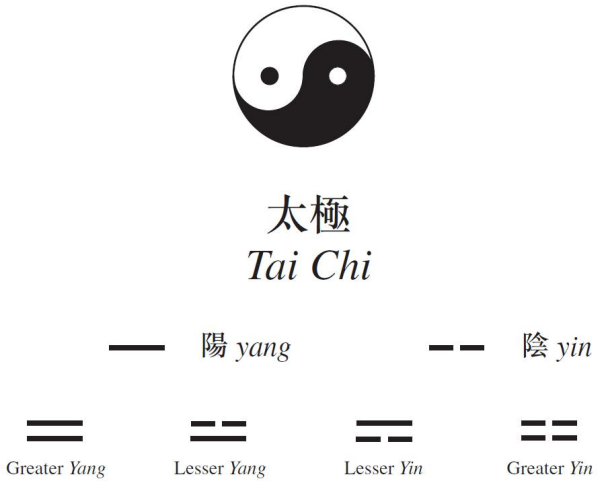


**Figure 1** Four aggregates based on tai chi
(Source: Extracted from Mak and So, 2011)

This scaling indicates that ancient scholars attempted to quantify *yin-yang*. Hence, buildings could also be classified into four *yin-yang* settings, as shown in Figure 2. A residential building, from a *Feng shui* perspective, could be considered bad when it is either tightly surrounded by buildings (*tai yin*) or totally exposed (*tai yang*), both highly unbalanced.

*Ming tang* (bright court) is a term frequently used in ancient Chinese architecture and is also a *Feng shui* jargon. In residential architecture, it represents the open space in front of the building entrance (Mak & Ng, 2005), equally applied to commercial architecture. The function of *Ming tang* is to construct a space to ease *sha qi* and store *sheng qi*. In this case, a grand *Ming tang* can be treated as a buffer to defuse those *sha qi* from roads, highways, and flyovers nearby and turn it into *sheng qi* for the benefit of the building and its occupants inside. Thus, *Ming tang* is critical to a building, in particular, a commercial building. Combined with the *yin-yang* setting, it is suggested that *Ming tang*, its size and shape, could be more influential to the building. It cannot be too large or too small and a concave shape is generally preferable.

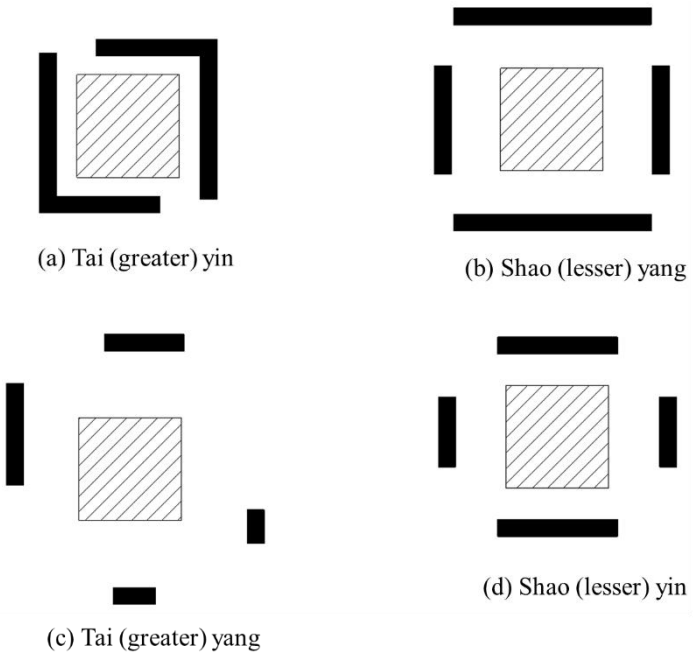


**Figure 2** Layout of residential buildings in four aggregates
(Source: Drawn by authors)

## 3.0 DEVELOPMENT OF THE MATHEMATICAL MODEL

*Feng shui* was claimed to be a superstition (De Groot, 1972). However, Freedman (1979) argued that *Feng shui* was not superstitious but based on self-evident propositions and the expertise of scientific men. Science is a study with experiments (Tam et al., 1999). This section applies a mathematical model to demonstrate the relationships of shopping malls' *Ming tang* and their business performance.

The model is developed by first understanding the four *yin-yang* settings which are described in Figure 2. The shaded square represents the target building and the black thick lines symbolize either surrounding buildings or streets. Figure 2(a) shows an extremely tight environment where the target building is closely surrounded by black thick lines, thus categorized as a *tai yin* setting. In Figure 2(c), the target building is too exposed, regarded as a *tai yang* setting. In Figures 2(b) and 2(d), the environment is neither too tight nor too exposed, thus considered *yin-yang* balanced. In comparison, the environment shown in Figure 2(b) is tighter than that in Figure 2(d), and hence Figure 2(b) is a *shao yang* setting, while Figure 2(d) is a *shao yin* setting.

The *yin-yang* settings in Figure 2 could be measurable, when converted to a nine-square model as shown in Figures 3(a) and 3(b). The nine-square model was developed from the classical *Feng shui Bagua* (eight trigrams) or *Lo Shu* square, also known as the magic square, and it has long been adopted by *Feng shui* practitioners (Kiehl, 2005). However, no mathematical rule has been developed so far.

In Figure 3(a), one central shaded block and eight surrounding blocks is a theoretically simplified layout plan frequently used in *Feng shui* classics to analyze *qi*. The nine-square model method has been applied to analyze single houses and courtyard houses (Hassan et al., 2021) and offices (Kiehl, 2005) for long by *Feng shui* masters. However, the discussion of the eight trigrams under the Compass School of *Feng shui* is beyond the scope of this research. Accordingly, the central block represents the target building and the surrounding eight blocks represent eight elements, aspirations, and directions when analyzing a building and its surroundings. The evaluation of *yin-yang* settings is also included. For instance, the borders of "*tai yang*" and "*tai yin*" in the direction of a corner block are proposed as shown in Figure 3(a), where the outer thicker dotted line is considered the limit of "*tai yang*" and the inner thinner dotted line is the limit of "*tai yin*". Any building outside the outer dotted line makes the target building too exposed and similarly too tight for any building within the inner dotted line.

Therefore, a mathematical model could be created. In Figure 3(b), considering the top left corner square, B marks the length between the center of the target building and the boundary of *tai yin,* and C represents the length between the center point and the boundary of *tai yang*. Measuring the distances between the center of the target building and the two dotted lines, B and C in Figure 3(b), could reveal the scopes of *tai yang* and *tai yin* in numbers, and thus numerically describe the *yin-yang* setting of the entrance. Suppose the width or length of the target building = A = 2 units. The distance between the building center and its corner = half the length of the diagonal = $\sqrt{2}$. Then, B = $1.5\sqrt{2}$ = 2.12 and C = $2.5\sqrt{2}$ = 3.54. Hence, the perpendicular distances of the two dotted lines from the center of the target building produce ratios of "1.5" and "2.5". When the ratio is over 2.5, the setting is considered *tai yang*, a ratio between 1.5 and 2.5 indicates a balance of *yin* and *yang* (*shao yin* or *shao yang*), and a ratio between 1.5 and 1.0 represents a condition of *tai yin.* Such ratios can also be extensible to the remaining four-sided squares as shown in Figure 3(b), where D/(A/2) = "2.5" and E/(A/2) = "1.5". D shows the length between the center of the target building and the boundary of *tai yang* and E marks the distance between the center point and the boundary of *tai yin*. Considering this concept, the use of such magic numbers is also extensible to irregular building shapes (Figure 3(c)).

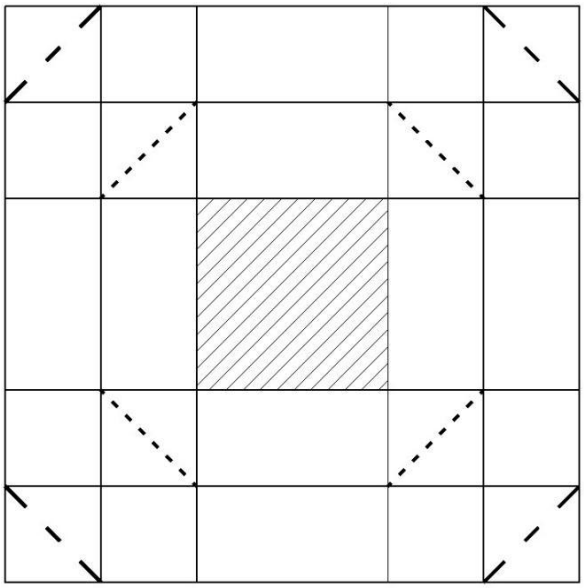

**Figure 3(a)** The nine-square model adopted by *Feng shui* practitioners
(Source: Kiehl, 2005, p. 21)

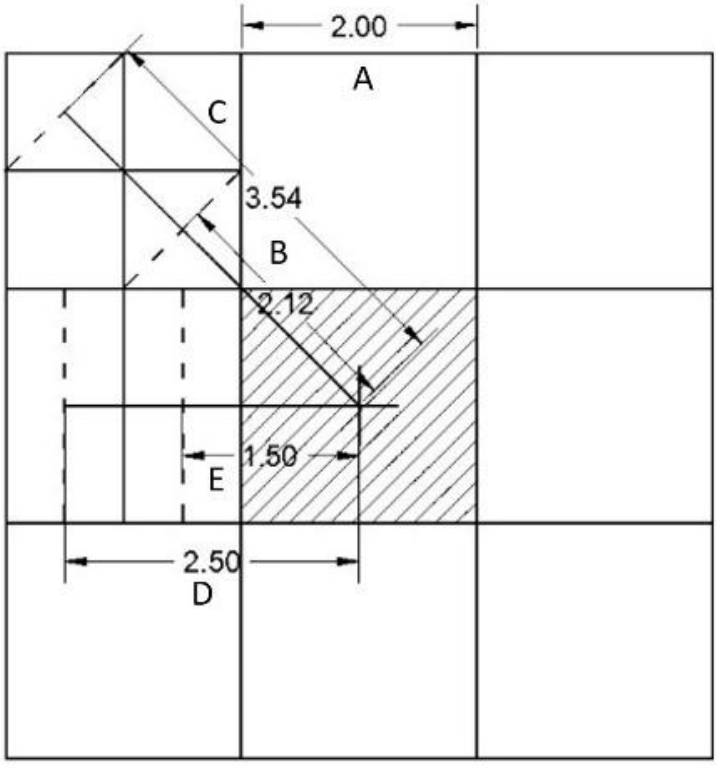


**Figure 3(b)** Mathematical model of four aggregates of surroundings of the target building
(Source: Drawn by authors)

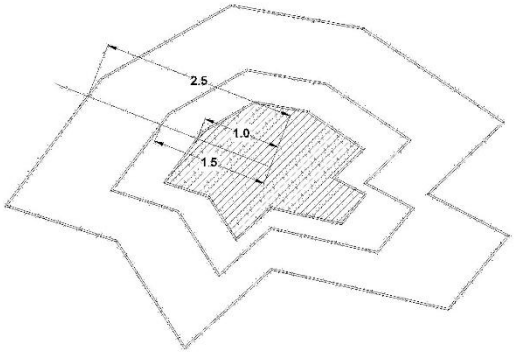


**Figure 3(c)** Model of irregular building
(Source: Drawn by authors)

In ancient times, commercial buildings such as shopping malls did not exist; the nine-square model was mainly applied to residential buildings. Nowadays, people visit shopping malls to shop, play, or dine, and they normally do not sleep and rest inside them. As such, in nature, shopping malls are more "active" or "dynamic" and thus require a more *yang* setting than residential buildings. Considering this, the scope of "*tai yang*" can be hypothetically enlarged for shopping malls so that the boundary may be slightly extended to go beyond "2.5". Further, as *Ming tang* is of utmost importance, the mathematical model should first be applied to all main entrances.

## 4.0 CASE STUDIES IN GUANGZHOU'S SHOPPING MALLS

The previous section developed a mathematical model using the nine-square concept of *Feng shui*. The application of the developed model to explain the real cases is shown in Figure 4. The polylines are drawn from the center of the building to the main entrance with a length B, and further to the pavement/street boundary with a length A, similar to the concept depicted in Figure 3(b). The ratio = A/B of the entrance is measured and calculated to indicate its *yin-yang* setting. The ratios are in general judged as "*tai yang*" (if > 2.5), "*shao yang*," "*shao yin*" (if between 2.5 and 1.5), or "*tai yin*" (if < 1.5). It was also hypothesized that shopping malls are slightly pro-*tai-yang* but certainly not pro-*tai-yin*. The street is public, not belonging to the land lot of the shopping mall. Hence, it is considered the outer boundary of the whole shopping mall area.

Three famous shopping malls in Guangzhou, the fifth largest city of China, namely, Tee Mall, Grandview Mall, and Haizhu Xinduhui Square, are analyzed by using this newly developed model. All of them are enclosed malls with multi-levels and sell similar types of goods and services. They are all located in populated downtowns and the first two are geographically located close to each other. The three shopping malls, shown in Figure 5, Figure 6, and Figure 7(b), are orientated with north pointing upward and south downward. As this paper does not address the Compass School of *Feng shui*, the exact orientation of the mall is beyond our discussion.

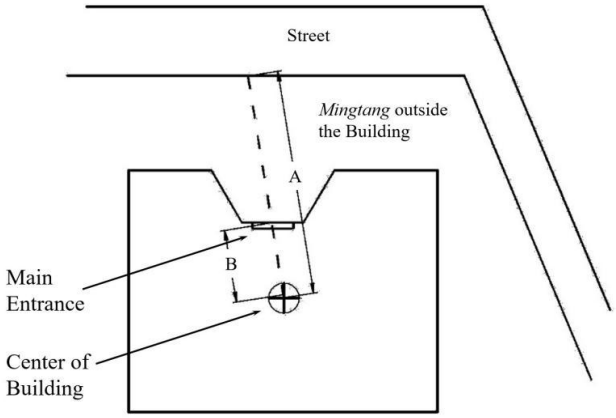


**Figure 4** Application of the mathematical model to the main entrance of a typical shopping mall, the *Ming tang*
(Source: Drawn by authors)

The mathematical model is applied to Figure 5, Figure 6, and Figure 7 and are edited using AutoCAD and an appropriate scaling factor to show the exact length of each measurement. By including polylines along the whole envelope of the shopping mall, AutoCAD's software feature "geometric center" can be executed to identify the center accurately.

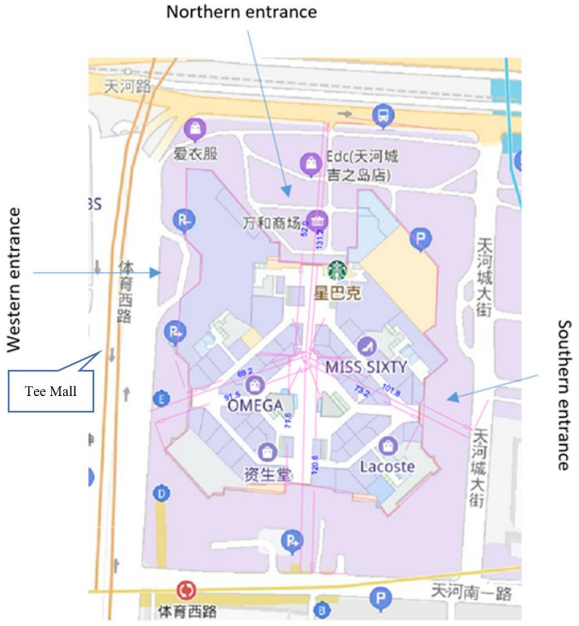


**Figure 5** The Tee Mall touched up by mathematical model applied to entrances
(Source: Drawn by authors on Baidu map)

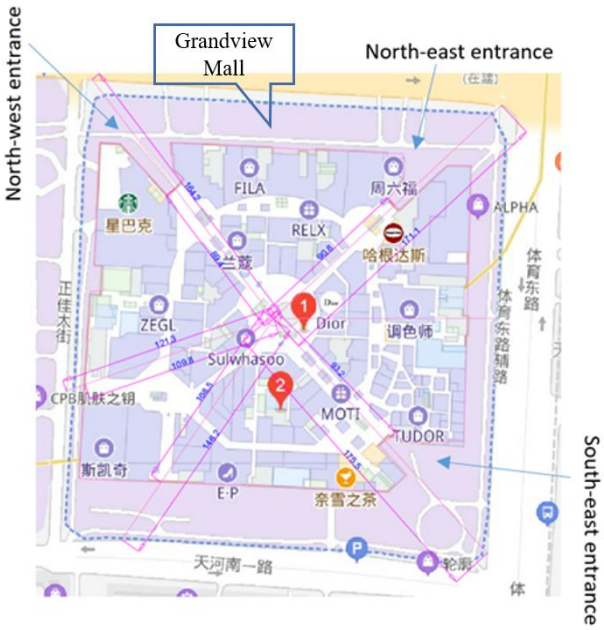


**Figure 6** The Grandview Mall touched up by mathematical model applied to entrances
(Source: Drawn by authors on Baidu map)

Tee Mall has been very popular since its opening in 1996. It has not undergone any large-scaled renovation since then but it has been ranked number one in terms of density and quantity of customers for the Pearl River Delta area. It has large *Ming tang*s at various entrances, particularly the main entrance facing the north and the back entrance facing the south. Figure 5 shows the layout plan of Tee Mall and its surrounding streets. Figure 5 shows the same plan modified by our mathematical model. It can be observed in Table 1 that the ratios of the four entrances are within or very close to the two magic numbers, "1.5" and "2.5". In particular, the northern main entrance has a ratio of 2.53, which is rather *yang* in nature.

Figure 6 shows the layout plan of Grandview Mall and its surrounding streets Figure 6 shows the same plan touched up by our mathematical model. Grandview Mall has been rated number two around the Pearl River Delta area. In Table 1, it can be observed that the building envelope to street boundary ratio of the main entrance is much smaller than that of Tee Mall. Fortunately, they are still within the magic ratio range between "1.5" and "2.5" for all three main entrances. Grandview Mall was opened in 2005. Though it is located close to Tee Mall, its performance can be considered slightly inferior.


**Figure 7** The Haizhu Xinduhui Square touched up by mathematical model applied to entrances
(Source: Drawn by authors on Baidu map)

Haizhu Xinduhui Square is close to busy roads. In general, it is of a "*tai yin*" setting. Figure 7 shows its layout and surrounding streets. Figure 7 shows how the mathematical model is applied to it. Table 1 shows that the ratio of the building center to the street boundary over that to the entrance is only 1.2, even smaller than the lower limit of "1.5", except the northern entrance which is merely at the minimum. The mall opened in 2014 and is located at a very good site with a dense residential population, even denser than the area of Tee Mall. However, this mall only attracts a limited number of customers and is not ranked in the list of shopping malls in Guangzhou. In other words, our mathematical model can predict its poor performance.

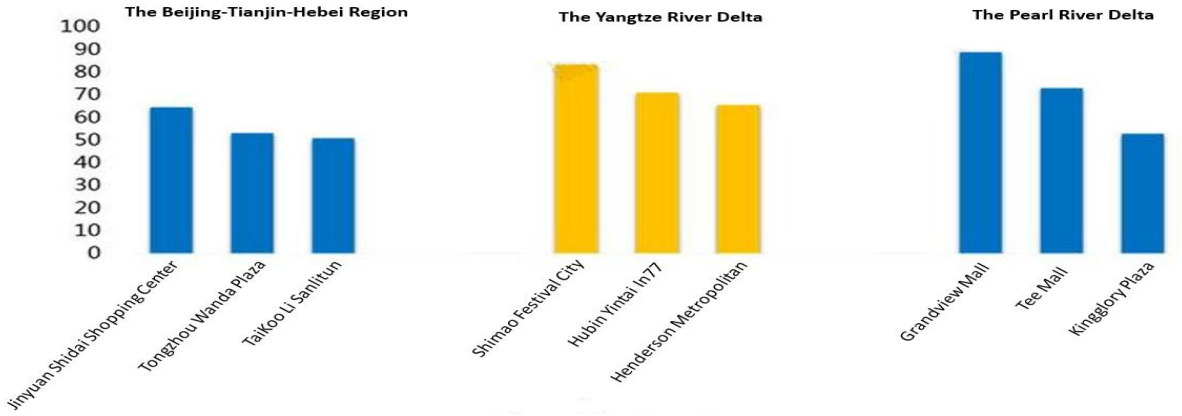


**Figure 8** Ranking list of shopping matters at three hubs of China
(Source: Translated from Winshang News, 2019)

Figure 8 is from a commercial survey on the business performances of three top shopping malls in each of the three main regions in China, namely Pearl River Delta, Yangtze River Delta, and Beijing-Tianjin-Hebei region. It can be observed that Tee Mall is ranked number 1, while Grandview Mall is ranked number 2 in the Pearl River Delta area. These performances of the shopping malls are in line with the results derived from the mathematical model that we developed and as shown in Table 1. The average ratios for Grandview and Tee Mall are 1.61 and 1.73 respectively, which is between 1.5 and 2.5. Such a result echos the fact that the two shopping malls could attract more customers while their business performance is better. The average ratio of Haizhu Xinduhui Square is only 1.28, less than 1.5 or "*tai-yin*", and that appears to correlate with the fact that this shopping mall has a relatively poorer business performance. It is worthwhile to note that the ratios are not the same for all the entrances in a shopping mall. For example, there are five entrances to Grandview Mall. The ratios of the three entrances are 1.84, 1.88, and 1.88 and the other two entrances are 1.35 and 1.11. Though the main entrances should be the focus, the implication of the other entrances should be studied in the future.

**Table 1** Results of the mathematical model application of the three shopping malls being studied

| Description of the entrance | Center to building enveloped (m) | Center to pavement / street boundary (m) | Ratio |
|---|---|---|---|
| **Tee Mall** | | | |
| Northern main entrance | 52.0 | 131.2 | 2.53 |
| South-eastern entrance | 73.2 | 101.8 | 1.39 |
| Southern main entrance | 71.6 | 120.6 | 1.69 |
| Southern-western entrance | 69.2 | 91.5 | 1.32 |
| Average | | | 1.73 |
| **Grandview Mall** | | | |
| North-western main entrance | 89.4 | 164.2 | 1.84 |
| North-eastern main entrance | 90.8 | 171.1 | 1.88 |
| South-eastern main entrance | 93.2 | 175.5 | 1.88 |
| South-western entrance | 108.5 | 146.2 | 1.35 |
| Western entrance | 109.8 | 121.3 | 1.11 |
| Average | | | 1.61 |
| **Haizhu Xinduhui Square** | | | |
| Northern entrance | 63.2 | 95.0 | 1.50 |
| South-eastern main entrance | 72.3 | 87.7 | 1.21 |
| Southern entrance | 47.6 | 59.5 | 1.25 |
| Western entrance | 34.7 | 40.7 | 1.17 |
| Average | | | 1.28 |

## 5.0 CONCLUSION

Through this research, we reveal that the shopping malls' entrances, particularly the space of *Ming tang* (the open area in front of an entrance), could be linked to their business performance as illustrated by the three case studies applying *Feng shui* theories. Although this result aligns with previous studies (O'Roarty et al., 1997), more cases will be studied in the future by adopting this mathematical model. The main contribution of this research is the development of a mathematical model to quantitatively analyze the four aggregates of *yin* and *yang* in *Yijing* and the nine-square model in *Feng shui* practices. The results of applying our mathematical model on the pilot case study show that the element of *sheng qi* is considered beneficial to business performance and *Ming tang*, a space in front of the entrance helps to draw in and store *sheng qi* and convert *sha qi* into *sheng qi*. *Yin-yang* balance can produce *sheng qi*. Two magic numbers "1.5" and "2.5" are proposed for dimensional ratios to evaluate the *yin-yang* setting of entrances of shopping malls. A satisfactory balance of *yin* and *yang* is considered when the ratio of *Ming tang* is between "1.5" and "2.5" as in this case, the settings would be *shao yang* and *shao yin* that is regarded *yin-yang* balanced. This is considered an improvement to *Feng shui* study as traditionally, *Feng shui* theories are descriptive and it is believed that the quantitative method could shed light on the scientific research of *Feng shui* in the future. The successful application of *Feng shui* theories in a modern context may also inspire the development of urban planning. By applying this model to three shopping malls in Guangzhou, it is found that our model could somehow match their business performance.

It should be noted that this is a tentatively simplified model and is expected to be polished when more factors are considered by further reviewing *Feng shui* theories. Essentially, more cross-provincial or even international shopping malls should be studied in the future to verify or testify our hypothesis. Considering the ratios, it is anticipated that the relative area of each *Ming tang* may also be of great importance, which will be elaborately investigated in the near future.

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