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Measuring the Effect Size of Coefficient of Determination and Predictive Relevance of Exogenous Latent Variables on Endogenous Latent Variables through PLS-SEM

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Abstract

In this paper the researchers investigated the effect size $f2$ of each independent variables was determined after the calculations relating to $R2$ value, p-values, t-values and bootstrap confidence intervals by using PLS-SEM (Partial least square-structural equation modelling). Effect size $f2$ is calculated in order to determine the individual constructs power and impact on endogenous latent variable, attachment. A relative measure of predictive relevance $q2$ effect size is also computed. To fulfil the aim of the study, a structured quantitative research survey has been conducted with 320 sample size. The results emerged from the research survey shows that the effect size of the service quality constructs on overall satisfaction of the consumers and level of attachment of consumers towards gym is small to medium. The $q2$ effect size of the impact of service quality constructs on overall satisfaction level of customers and levels of attachment of customers towards gym is medium to large. At the end we observed a

decreased in the R-square value, thus leading to a conclusion that removing the measures has resulted in decreasing the explanatory power of the model. Finally research highlights the results, along with implications and limitations.

Type of Paper: Empirical

Key Words: Service quality, customer attachment, overall satisfaction, q2 effect size, predictive relevance.

1. Introduction

Butcher (2001) posited attachment involves consumers' repurchase intention as well as the positive word-of-mouth by recommending the product/service to others. The constructs addressed by prior research on the basis of phenomenological grounded theory and path breaking work has shown the lasting strong bond between consumer satisfaction and attachment. In this paper the researchers investigated the effect size f^2 of each independent variables was determined after the calculations relating to R^2 value, p-values, t-values and bootstrap confidence intervals. A relative measure of predictive relevance q^2 effect size is also computed. To fulfil the aim of the study, a structured quantitative research survey has been conducted with 320 sample size. The results emerged from the research survey shows that the effect size of the service quality constructs on overall satisfaction of the consumers and level of attachment of consumers towards gym is small to medium. The q^2 effect size of the impact of service quality constructs on overall satisfaction level of customers and levels of attachment of customers towards gym is medium to large. At the end we observed a decreased in the R-square value, thus leading to a conclusion that removing the measures has resulted in decreasing the explanatory power of the model. Finally research highlights the results, along with implications and limitations.

2. Literature Review

Across industries, measuring customer satisfaction has become a vital issue as it lays foundation to many strategic decisions (Neigle Piersi, 1996). Empirical evidence in the domain of service quality illustrates that customer satisfaction is also a source of long term growth and stability of an organization (Rust & Zahorik, 1993). Considerable quantum of research has been undertaken to determine the antecedents of service quality in the fitness industry and to assess its impact on customer satisfaction. QUSEC model of service quality assessment has been applied by Afthinos et al, (2005) among the fitness centers in Greece. Kriegl (2000) and Macintosh and & Doherty (2007) have also explored a positive association between service quality offered at fitness center and customer satisfaction. Scholars have argued that consumer satisfaction and attachment could also be the result of relationship marketing program me (McDaniel and Moore, 2005). In the present study, the construct of customer attachment is measured by six exogenous latent variables namely, quality of staff, quality of program me, quality of locker room, physical facilities, workout facilities and consumer satisfaction. Physical arousal of bodily response and cognitive interpretation on fitness aspects leads to emotional attachment due to attitudinal loyalty Alexandris et al. (2006). Research also showed that attitudinal loyalty is conceptually same to attachment (Kyle et al., 2004). Besides physical environment, the interaction quality is the strong predictor of attachment (Alexandris et al. 2006).

3. Research Methodology

Study design used in this research will be cross sectional study where consumers are contacted at Zuese gym, located in Karnataka state, Mangalore, India and data pertaining to research is collected directly from the subjects who make use of available facilities according to their exercise systematically and who are into workout and fitness from past one year and above. Formula used to derive sample size is as follows:

$$n = \frac{Z^2_\alpha \times PQ}{E^2}$$

$$= \frac{(1.96)^2 \times (0.5)(0.5)}{\left(\dfrac{0.5 \times 11}{100}\right)^2} = 320$$

Selection of each sample will be based on non-probability purposive sampling. Those who are just joined for gym are not taken in to consideration. In this study, Lam et al., (2005) "the Service Quality Assessment Scale" (SQAS) is employed for finding out the dimensional structure of a fitness center in Mangalore Zuese gym. The pre structured preform will be distributed to subjects after informing about the objective of study. The main instruments will be used in this research are Rensis Likert's 5 rating scale.

4. Results

4.1. Calculating Effect Size f^2

The effect size of the each of the independent variables was calculated after the calculations relating to R^2 value, p-values, t-values and bootstrap confidence intervals. This study measured the same by calculating f^2 effect size:

$$f^2 = \frac{R^2\ included - R^2\ excluded}{1 - R^2\ included}$$

The rule of thumb that the prior research advocates, in order to decide upon the significance of the effect size, state that the effect size values of 0.02, 0.15 and 0.35 represent small, medium and large effect sizes respectively (Cohen, 1988).

Running the PLS-SEM algorithm after the exclusion of the construct of levels of satisfaction related to staff, the effect size of the direct effect of the levels of satisfaction related to staff and overall satisfaction level of customers as well as

levels of satisfaction related to staff and levels of attachment of customers towards gym is calculated as follows:-

$$f^2_{A \to F} = \frac{0.369 - 0.368}{1 - 0.369} = \frac{0.001}{0.631} = 0.001$$

$$f^2_{A \to G} = \frac{0.336 - 0.335}{1 - 0.336} = \frac{0.001}{0.664} = 0.001$$

The calculated effect size of overall satisfaction level of customers and levels of attachment of customers towards gym, are 0.001 and 0.001 respectively is case of small effect size. This implies that the effect size of the levels of satisfaction related to staff and overall satisfaction level of customers as well as levels of satisfaction related to staff and levels of attachment of customers towards gym is "small to medium".

The PLS-SEM algorithm was run to find out the effect size of the direct effect of levels of satisfaction related to programme and overall satisfaction level of customers as well as levels of satisfaction related to programme and levels of attachment of customers towards gym. The effect size of the direct effect of the levels of satisfaction related to programme and as well as levels of satisfaction related to programme and levels of attachment of customers towards gym is calculated as follows:-

$$f^2_{B \to F} = \frac{0.369 - 0.366}{1 - 0.369} = \frac{0.003}{0.631} = 0.004$$

$$f^2_{B \to G} = \frac{0.336 - 0.320}{1 - 0.336} = \frac{0.016}{0.664} = 0.024$$

The calculated effect size of the levels of satisfaction related to programme and overall satisfaction level of customers as well as levels of satisfaction related to programme and levels of attachment of customers towards gym, are 0.004 and 0.024 respectively is case of small effect size. This implies that the effect size of the levels of satisfaction related to programme and overall satisfaction level of customers as well as levels of satisfaction related to programme and levels of attachment of customers towards gym is "small to medium". The effect size of the direct effect of the levels of satisfaction related to the locker room facilities and overall satisfaction level of customers as well as levels of satisfaction related to the locker room facilities and levels of attachment of customers towards gym is calculated as follows:-

$$f^2_{C \to F} = \frac{0.369 - 0.366}{1 - 0.369} = \frac{0.003}{0.631} = 0.004$$

$$f^2_{C \to G} = \frac{0.336 - 0.329}{1 - 0.336} = \frac{0.007}{0.664} = 0.010$$

The calculated effect size of the levels of satisfaction related to the locker room facilities and overall satisfaction level of customers as well as levels of satisfaction related to the locker room facilities and levels of attachment of customers towards gym, are 0.004 and 0.010 respectively is case of small effect size. This implies that the effect size of the levels of satisfaction related to the

locker room facilities and overall satisfaction level of customers as well as levels of satisfaction related to the locker room facilities and levels of attachment of customers towards gym is "small to medium". The effect size of the direct effect of the levels of satisfaction related to physical facilities and overall satisfaction level of customers as well as levels of satisfaction related to physical facilities and levels of attachment of customers towards gym is calculated as follows:-

$$f_{D \to F}^2 = \frac{0.369 - 0.337}{1 - 0.369} = \frac{0.032}{0.631} = 0.050$$

$$f_{D \to G}^2 = \frac{0.336 - 0.336}{1 - 0.336} = \frac{0.000}{0.664} = 0.000$$

The calculated effect size of the levels of satisfaction related to physical facilities and overall satisfaction level of customers as well as levels of satisfaction related to physical facilities and levels of attachment of customers towards gym, are 0.050 and 0.000 respectively is case of small effect size. This implies that the effect size of the levels of satisfaction related to physical facilities and overall satisfaction level of customers as well as levels of satisfaction related to physical facilities and levels of attachment of customers towards gym is "small to medium".

The effect size of the direct effect of the levels of satisfaction related to workout facilities and overall satisfaction level of customers as well as levels of satisfaction related to workout facilities and levels of attachment of customers towards gym is calculated as follows:-

$$f_{E \to F}^2 = \frac{0.369 - 0.214}{1 - 0.369} = \frac{0.155}{0.631} = 0.245$$

$$f_{E \to G}^2 = \frac{0.336 - 0.318}{1 - 0.336} = \frac{0.018}{0.664} = 0.027$$

The calculated effect size of the levels of satisfaction related to workout facilities and overall satisfaction level of customers as well as levels of satisfaction related to workout facilities and levels of attachment of customers towards gym, are 0.245 and 0.027 respectively is case of small effect size. This implies that the effect size of the levels of satisfaction related to workout facilities and overall satisfaction level of customers is medium to large and levels of satisfaction related to workout facilities and levels of attachment of customers towards gym is "small to medium".

Table 1: Predictive relevance (Q^2) and coefficient of determination (R^2).

Sl.No.	Latent Variable	R^2	Q^2
1.	Overall satisfaction level of customers	0.369	0.160
2.	Levels of attachment of customers towards gym	0.336	0.128

4.2. Calculating q² Effect Size

The q2 effect size explains the 'relative impact of predictive relevance' with the values of 0.02, 0.15 and 0.35 are indicative of small, medium and large effect

sizes (Cohen, 1988). The q2 effect size can be calculated for all constructs by using the following formula:

$$q^2 = \frac{Q^2 \ included - \ Q^2 \ excluded}{1 - \ Q^2 \ included}$$

Table 2: Effect sizes of predictive relevance.

Constructs (Service quality with levels of attachment of customers towards gym)	q^2 Effect size	Effect
levels of satisfaction related to staff	0.209	Medium to large
levels of satisfaction related to programme	0.207	Medium to large
levels of satisfaction related to the locker room facilities	0.207	Medium to large
levels of satisfaction related to physical facilities	0.191	Medium to large
levels of satisfaction related to workout facilities	0.119	Small to medium
Constructs (Service quality with overall satisfaction level of customers)		
levels of satisfaction related to staff	0.199	Medium to large
levels of satisfaction related to programme	0.190	Small to medium
levels of satisfaction related to the locker room facilities	0.194	Small to medium
levels of satisfaction related to physical facilities	0.199	Medium to large
levels of satisfaction related to workout facilities	0.189	Small to medium

5. Discussion

Research indicates that the effect size of the 'quality of staff' and 'overall satisfaction level of customers' as well as 'quality of staff' and 'attachment of customers towards gym' is "small to medium". This result also reveals that the effect size of the 'quality of programme' and 'overall satisfaction level of customers' as well as 'quality of programme' and 'levels of attachment of customers towards gym ' is "small to medium". Further, research also highlights that the effect size of the 'the locker room facilities' and 'overall satisfaction level of customers' as well as 'locker room facilities' and 'levels of attachment of customers towards gym' is "small to medium". Research also indicates that the effect size of the 'workout facilities' and 'overall satisfaction level of customers' is medium to large and 'workout facilities' and 'levels of attachment of customers towards gym' is "small to medium". In order to observe the incremental change in R-square value when removing those measures with low path coefficients, several path estimate tests were conducted

by excluding these measures one at a time. At the end of this test, we observed a decreased in the R-square value, thus leading to a conclusion that removing the measures has resulted in decreasing the explanatory power of the model. This observation indicates that some measures may not be a strong predictor to the construct, however, it is still significantly relevance with no indication of collinearity. Therefore, we argued that all 34 measures provide strong contribution to the Impact construct and should be retained.

6. Conclusion

Running the PLS-SEM algorithm after the exclusion of the construct of 'quality of staff', the calculated effect size of 'overall satisfaction level of customers' and 'attachment of customers towards gym', are 0.001 and 0.001 respectively is case of small effect size. The calculated effect size of the 'quality of programme' and 'overall satisfaction level of customers' as well as 'quality of programme' and 'levels of attachment of customers towards gym', are 0.004 and 0.024 respectively is case of small effect size after running the PLS-SEM algorithm after the exclusion of the construct of 'quality of programme'. From the calculation q^2 effect size of the impact of 'quality of staff' on 'overall satisfaction level of customers' as well as 'quality of staff' on 'attachment of customers towards gym' is 'medium to large'. But the q2 effect size of the impact of 'quality of programme' on 'overall satisfaction level of customers' as well as 'quality of programme' on 'attachment of customers' is 'medium to large'. Further, q^2 effect size of the impact of 'locker room facilities' on 'overall satisfaction level of customers' as well as 'locker room facilities' on 'levels of attachment of customers towards gym' is 'medium to large'. Again, the q^2 effect size of the impact of 'physical facilities' on 'overall satisfaction level of customers' as well as 'physical facilities' on 'levels of attachment of customers is 'medium to large'.

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