ISLAMIC MUTUAL FUNDS PROMOTIONAL ACTIVITIES: NORMAL APPROXIMATION OF BINOMIAL DISTRIBUTION AND TYPE I ERROR

Mohd Yaziz Bin Mohd Isa[1,§], **Hannan Azzahra**[2] and **Zulkiffllee Mohamed**[3]

[1,2,3] Universiti Tun Abdul Razak, Malaysia
[§] Corresponding author: mohd_yaziz@unirazak.edu.my

ABSTRACT

The paper applies normal approximation procedure to binomial probability distribution. A sample of 392 respondents are surveyed whether they agree or not agree that promotional activities determined the level of awareness of benefits of Islamic mutual funds. The paper hypothesizes the population mean μ of *success* effects of promotional activities at 68%, and attempts to reduce Type I error - the probability of rejecting null hypothesis when it is true.

Keywords: Binomial probability distribution, normal probability distribution, Islamic mutual funds.

1. INTRODUCTION

The purpose of this paper is to attempt estimating a normal probability distribution, which is a continuous probability distribution as a substitute to a binomial probability distribution of promotional activities of Islamic mutual funds. The binomial probability distribution on the other hand is a discrete probability distribution. The paper also discusses the risk of committing Type I error i.e. probability of rejecting null hypothesis when it is true.

The responses from an opinion polling of effects of promotional activities of Islamic mutual funds are in form of binomial probability distribution. The respondents have been asked, "*do you agree that promotional activities determined the level of awareness of benefits of Islamic mutual funds?*". One obvious reason to substitute using the normal probability for approximating the binomial distribution is for large values of *n* (i.e. sample size) a binomial distribution becomes closer and closer to normal distribution (Lind, Marchal and Wathen, 2015). The opinion polling where the normal approximation had been applied to approximate the binomial distribution is such an example. Another reason is the estimation procedure becomes more efficient through the use of normal probability approximation for the binomial distribution for a survey with large value of *n*. By extension, the reason to determine risk of committing Type I error in the estimation procedure is to control Type I error. Ramsey and Ramsey (1988) advocate the view that normal approximation as robust for a given sample size *n* and at a given level of α (the risk of Type I error) if the error never exceeds 1.5 α.

In this paper, the binomial parameter to denote "*success"* of an outcome is when respondents respond as "*agree"* that promotional activities determined the level of awareness of benefits of Islamic mutual funds. The calculated "*success*" is 68%. This percentage is arrived at because from the survey 267 respondents of total 392 respondents responded "*agree*" promotional activities determined the level of awareness of benefits of Islamic mutual funds.

As in any binomial distribution, there can be only two mutually exclusive possible outcomes (events or replies) in the opinion polling. The possible outcomes are either "*success*" or "*failure"*. Henceforth, the "*failure*" outcome is when the respondent does not agree (that promotional activities determined the level of awareness of benefits of Islamic mutual funds). Since the "*success*" outcome is 68% (or 0.68) the "*failure*" outcome is 32% (1-0.68=0.32). As stated earlier, a condition for binomial experiment is that respondent can choose only one of two possible responses either "*agree*" or "*does not agree*"; but the respondent cannot choose both responses at the same time.

Generating a binomial probability distribution for a large number of respondents, for example, for 300 respondents in this paper would become more efficient using normal probability distribution. Because when the sample size is large and exceeding *n=30*, binomial distribution automatically approaches normal distribution.

2. LITERATURE REVIEW

The size of Islamic capital market in Malaysia stands at RM1,961.73 billion (Securities Commission Malaysia, 2018) as at 31st August 2018. It constitutes about 60.33% of total market share of capital market of RM3,251.67 billion.

Of the total asset of RM790.80 billion (@ 31st August 2018), RM171.53 billion (or 21.69%) comprises of Islamic assets (Securities Commission Malaysia, 2018). The composition of Islamic assets of 21.69% as at 31st August 2018 is increasing over the years from 19.82% (@ December 2015) to 21.49% (@ December 2016) and then to 22.01% (@ December 2017).

The Islamic mutual fund is a form of collective investment that allows investors to pool their funds to invest by fund professionals in portfolio of assets or securities that are Shariah-compliant. Some examples of the assets or securities that are Shariah-compliant are Islamic-counters securities, sukuk, Islamic unit trusts, Shariah indices, warrants, call warrants, and crude palm oil futures contract. The Shariah compliance matter is what makes the Islamic mutual funds differ from that of their conventional counterparts.

The increasing in the number of Shariah-compliant funds available in the market and the growing units purchase over the years demonstrates great potential of both the demand and the supply of the funds. But the present market conditions post imminent challenges. The number of investors is increasing at a declining rate and it gives rise to a question "*why do they prefer to invest in conventional mutual funds?*" There is also a lack of awareness among investors and their understanding about the roles of fund professionals and an understanding about what differentiate Islamic mutual funds from that of their conventional counterparts. A lack of variety in product offerings according to Yusuff and Mansor, 2014 is another contributing factor. As a result, creating awareness among investors at the basic level is an increasingly important area in promoting and marketing of Islamic mutual funds.

Brand awareness is defined as the level of involvement which begins with brand name recognition. The lowest level of brand awareness is simply recognizing the brand name while the highest level is the ability to develop a detailed information about the products and services offered based on the brand name. Many studies show the consumers' behaviours are influenced by awareness and knowledge about the products and services offered. (Chartrand, 2005; Coulter et al. 2005; Dommeyer & Gross, 2003; Donoghue & De Klerk, 2009; Hartlieb & Jones, 2009; McEachern & Warnaby, 2008; and Thomas & Mills, 2006).

The use of standard normal probability distribution to approximate binomial probability distribution when there is a large value of "*n"* (i.e. *n* is a sample size) is an alternative or an option. It is so because as "*n"* increases, a binomial probability distribution becomes closer and closer to resemble a standard normal probability distribution.

Returning to the criteria for binomial probability distribution, they are:

i. There are only two mutually exclusive outcomes or outputs either "agree" or "does not agree*"* to an opinion polling or question "*promotional activities determined the level of awareness of benefits of Islamic mutual funds?"*.
ii. The probability of "*success"* in each experiment or survey remains the same from one respondent to another. This probability is calculated from the opinion polling or survey respond, where 68% (i.e. 267 of 392 respondents) indicate they "*agree*" that promotional activities determined the level of awareness of benefits of Islamic mutual funds. In other words, the level of awareness of benefits of Islamic mutual funds is determined by promotional activities as the likely response from each respondents remains the same at 0.68. So, $\pi = 0.68$.
iii. The "trials" or responses are independent of each other, meaning - for example, if the 10th respondent agrees, it does not affect whether the 11th respondent agrees. Likewise, if the 10th respondent does not agree it does not affect whether the 11th respondent does not agree.
iv. $n\pi$ and $n(1-\pi)$ are both at least 5 according to Lind, Marchal and Wathen, 2015. In this paper $n\pi = 392\ (0.68) = 266.56$ therefore $n\pi \geq 5$, and $n(1-\pi) = 392(0.32) = 125.44$ therefore $n(1-\pi) \geq 5$.

3. METHODOLOGY

The paper attempts to find from a random sample "*at least 300 respondents"* agree promotional activities determined the level of awareness of benefits of Islamic mutual funds. At a chosen level of significance at 1%, the hypothesis is set as below. We hypothesize the population mean μ of *success* effects of promotional activities is 68% (based on 267 of 392 respondents surveyed who indicate they "*agree*");

$H_{0:}$ $\mu \leq$ 0.68% of respondents agree the promotional activities *did not* determine the level of awareness of benefits of Islamic mutual funds (the hypothesis tested).

$H_{0:}$ $\mu >$ 0.68% of respondents agree the promotional activities *determined* the level of awareness of benefits of Islamic mutual funds (the research hypothesis).

In the procedure where normal approximation substitutes for binomial probability distribution, a value of 0.5, termed as "*continuity correction factor*" is applied. In short, it is applied in the estimation procedure to find the probability "*at least 300 respondents"* agree promotional activities determined the level of awareness of benefits of Islamic mutual funds. In order to apply the "*continuity correction factor*" to the value of "*at least 300 respondents*" the estimation procedure begins from 299.5 (i.e. 300-0.5=299.5).

The binomial distribution is given by the formula: $P(x; n, \pi) = \sum_{x=0}^{n} \binom{n}{x} \pi^x \, q^{n-x}$ for x=1,2,3….n.

$P(X \geq 300;392,0.68) = \sum_{x=300}^{n=392} \binom{392}{300} \pi = 0.68^{300} \; q = 0.32^{392-300=92}$ for x = 300,301,…392.

$P(X = x) = {}_n C_x \, (\pi)^n \, (1-\pi)^{n-x}$

$= \frac{n!}{x!\,(n-x)!\,(\pi)^x\,(1-\pi)^{n-x}}$

4. RESULTS & DISCUSSIONS

Now returning to the purpose of the paper, to find the probability randomly selected respondents from the 392 total respondents "*at least 300 respondents"* agree promotional activities determined the level of awareness of benefits of Islamic mutual funds, the construction of the binomial probability methodology is as follows:

4.1 Binomial probability construction

The binomial distribution is calculated as follows;

Firstly, $P(x = 300) = {}_{392} C_{300} \, (\pi)^{300} \, (1-\pi)^{392-300}$

$= {}_{392} C_{300} \, (0.68)^{300} \, (1-0.68)^{392-300}$

$= 0.000046391$

We continue further with x = 301.

$P(x = 301) = {}_{392} C_{301} \, (\pi)^{301} \, (1-\pi)^{392-301}$

$= 0.000030131$

And, further with x = 302, and so forth.

$P(x = 302) = {}_{392} C_{302} (\pi)^{302} \, (1-\pi)^{392-302} = 0.000019293$

$P(x = 303) = {}_{392} C_{303} (\pi)^{303} \, (1-\pi)^{392-303} = 0.000012178$

$P(x = 304) = {}_{392} C_{304} (\pi)^{304} \, (1-\pi)^{392-304} = 0.000007576$

$P(x = 305) = {}_{392} C_{305} (\pi)^{305} \, (1-\pi)^{392-305} = 0.000004645$

In summary, the procedure continues further with x = 306 and so forth for all the 392 respondents until last where x = 392 to find the probability "at least 300 respondents" agree promotional activities determined the level of awareness of benefits of Islamic mutual funds.

We then sum of the total probabilities for all values of x from the first respondent (300th) to the last (392th). However, the calculation procedure by this method would be tedious, time-consuming and impractical. Using this method, we measure the probability for 93 times (one time for each value of x from x=300 to x=392 inclusive). In real applications, the binomial tables may not be available because the number of trials (300) is so large.

4.2 Normal approximation to Binomial probability distribution

Returning to the purpose of the paper to substitute using normal approximation to binomial probability distribution to determine the probability "*at least 300 respondents"* agree that promotional activities determined the level of awareness of benefits of Islamic mutual funds, we use the area *below* x = 300-0.5 (i.e. x = 299.5 after subtracting 0.5 from 300). Therefore, x = 299.5.

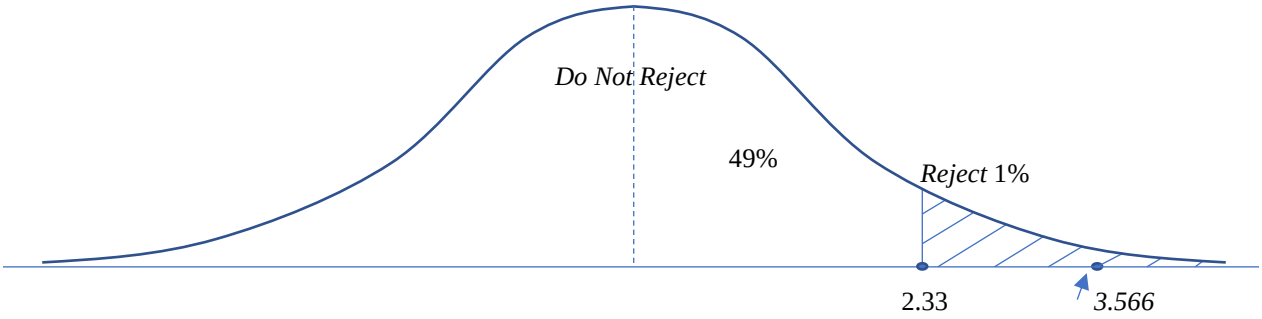
To find the Z-value corresponding to x=299.5 with the μ for a binomial probability distribution which is $\mu = n\pi = 392(0.68) = 266.56$, and the variance $n\pi\ (1-\pi) = 392(0.68)(1-0.68)=85.2992$, and standard deviation = 9.2357

$$P\ (299.5 \leq X \leq 392.5) = \text{Z-value} = \frac{\bar{x} - \mu}{\text{Std. deviation}}$$

$$= \frac{299.5 - 266.56}{9.2357} = 3.566$$

Under the normal curve with a Z-value = 3.566 lies within rejection region (beyond 2.33), H_0 is *rejected*. It implies the probability of obtaining such an extreme estimate of 2.33 standard deviation *above* from the μ is *less* than 1% (the chosen level of significance).

Therefore, it can be concluded that 0.68% of respondents agree the promotional activities *determined* the level of awareness of benefits of Islamic mutual funds.

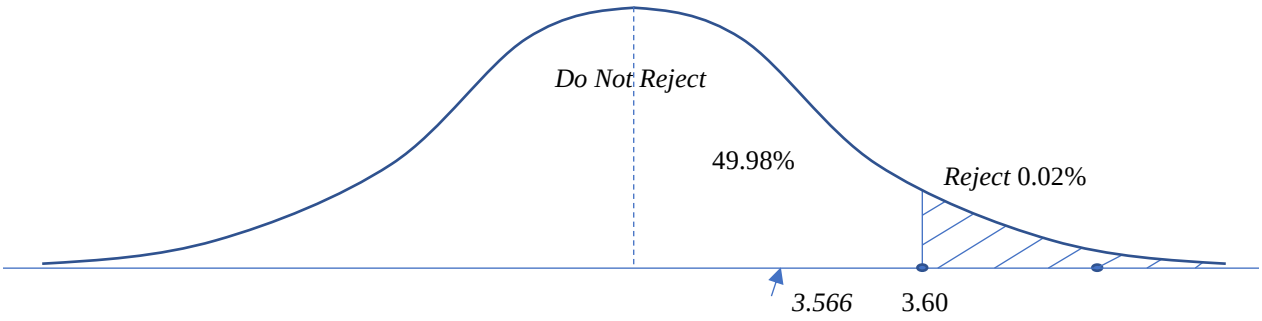


Critical value based on z-table

4.3 TYPE I error

Type I error is the probability of rejecting null hypothesis when it is true. In the above calculations, suppose that null hypothesis is true, there is a 1% chance that μ is larger than 2.33 that we decide to reject the null hypothesis. In short, there is a 1% chance of committing a type I error.

We can reduce the risk of committing type I error by reducing the size of the rejection region. We could lower (revise) the level of significance from 1% (as in graph above) to 0.02% (as in graph below). With the lower level of significance at 0.02%, it implies that the probability of getting the sample value is now 0.02%. Now our chance to make type I error is 0.02% of the time.



Critical value based on z-table

With the lower level of significance of 0.02%, under the normal curve with a Z-value = 3.566 lies within non-rejection region (below 3.60), H_0 is *not* rejected.

5. CONCLUSIONS

In conclusion, 0.68% of respondents agreed that promotional activities *determined* the level of awareness of benefits of Islamic mutual funds. As such, the null hypothesis that H_0: $\mu \leq$ 0.68% was rejected at 1% level of significance. At the lower level of significance of 0.02% however, H_0 was *not* rejected. Future study may explore relationship on the level of consumer awareness with purchase intentions of Islamic mutual funds.

References

Biswal, Purna Chandra (2009), "*Probability and Statistics*", PHI Learning Private Limited, New Delhi

Brown, Lawrence D., Cai, T. Tony and DasGupta, Anirban (2001), "*Interval Estimation for Binomial Proportion*", Statistical Science, Vol. 16, No. 2, pp. 101-133

Chartrand, T. L. (2005). The role of conscious awareness in consumer behavior. *Journal of Consumer Psychology*, 15(3), pp. 203-210.

Coulter, R. A., Price, L. L., Feick, L., & Micu, C. (2005). The evolution of consumer knowledge and sources of information: Hungary in transition. *Journal of the Academy of Marketing Science*, 33(4), pp. 604-619.

Dommeyer, C. J., & Gross, B. L. (2003). What consumers know and what they do: An investigation of consumer knowledge, awareness, and use of privacy protection strategies. *Journal of Interactive Marketing*, 17(2), pp. 34-51.

Donoghue, S., & De Klerk, H. M. (2009). The right to be heard and to be understood: a conceptual framework for consumer protection in emerging economies. *International Journal of Consumer Studies*, 33(4), pp. 456-467.

Hartlieb, S., & Jones, B. (2009). Humanising business through ethical labelling: Progress and paradoxes in the UK. *Journal of Business Ethics*, 88(3), pp. 583-600.

Lind, Douglas A., Marchal, William G. and Wathen, Samuel A. (2015), "*Statistical Techniques in Business & Economics*", Sixteenth edition, New York, NY, McGraw Hill Education

McEachern, M. G., & Warnaby, G. (2008). Exploring the relationship between consumer knowledge and purchase behaviour of value-based labels. *International Journal of Consumer Studies*, 32(5), pp. 414-426.

Ramsey Phillip H. & Ramsey Patricia P. (1988), "*Evaluating the Normal Approximation to the Binomial test*", Journal of Educational and Behavioral Statistics", vol. 13, Issue 2, pp. 173-182

Selvanathan Anthony, Selvanathan Saroja, Keller Gerald and Warrack Brian (2000), "*Australian Business Statistics*", Nelson Thomson Learning, South Melbourne Victoria, Australia.

Thomas, L., & Mills, J. E. (2006). Consumer knowledge and expectations of restaurant menus and their governing legislation: a qualitative assessment. *Journal of Foodservice*, 17(1), pp. 6-22.

Triola Mario F. (2017), "*Elementary Statistics*", Thirteen edition, Pearson Addison Wesley, Boston, USA

Yusuff, Noraini & Mansor, Fadillah (2014), Journal of Global Business and Social Entrepreneurship (GBSE) Vol. 1, No. 2, pp. 113-120

Note:

1. 22.38 million of population of Malaysia is in a 15-64 years old i.e. working-age group. This is arrived at based on 69.5% of 32.2 million, the total population of Malaysia from the Demographic Statistics 4th Quarter 2017 of the Department of Statistics, Malaysia.