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Using Model of Split-Plot Design in the Study of Factors Affecting on Accepted in Stock Exchange Agricultural Machinery Companies Liquidity

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Abstract

Split-plot designs were originally developed by Fisher (1925) for use in agricultural experiments. Aim of this research is the study of factors affecting on liquidity accepted in stock exchange Agricultural Machinery companies by Split-Plot design model. Presented this research for all five Agricultural Machinery Companies that accepted in Tehran Stock Exchange since (1388–1390) and sample is equals with society. Research method is descriptive and based on the target is application. In this model $(\tau\beta)_{ij}$ is still the whole plot error but the blocks × B and blocks × AB interactions have essentially been pooled with ε_{ijk} to form the subplot error. According to the results, we see that ratios type and company type and Interaction ratio type and company type affected the company's liquidity. Then hypotheses 2, 3 and 4 can't be rejected at the 95% confidence level. In this research, the various liquidity ratios called plot that these can calling block. We see that ratios type and company type and Interaction ratio type and company type affected the company's liquidity. Future research is suggested from other models should be used, including repeated factorial designs, Nested factorial design in evaluation of the impact factorials on the liquidity of companies.

Keywords: Cash Ratio, Current Ratio, Factorial Experiments, Liquidity, Quick Ratio, Split-Plot Design

1. Introduction

Investors to invest in companies should be aware of the factors affecting the liquidity of companies then we use Split-Plot design model that it is experimental design and this problem can be solved.

Experimental design methods have found potential application in many disciplines. In fact, we may view experimentation as part of the scientific process and as one of the ways we learn about how systems or processes work.

Experimental design is a critically essential tool in the industry for improving the performance of a manufacturing process. It also has extensive application in the development of new processes. The application of experimental design techniques early in process development can result in

- Improved process yields.
- Reduced variability and closer conformance to nominal or target requirements.
- Reduced development time.
- Reduced overall costs.

Experimental design methods also play a major role in engineering design activities, where new products are developed and existing ones improved. Some applications of experimental design in engineering design includes

- Evaluation and comparison of basic design configurations.
- Evaluation of material alternatives.

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- Selection of design parameters so that the product will work well under a wide variety of field conditions, that is, so that the product is robust.
- Determination of key product design parameters that impact product performance.

The use of experimental design methods in these areas can result in products that are easier to manufacture, products that have improved field reliability and performance, shorter product, and lower product cost design and development time.

In a characterization experiment, we are usually wanted to determine which process variables affect the response. A logical next step is to optimize, that is, to define the region in the main factors that leads to the best possible response. For example, if the response is yield, we would look for a region of maximum yield, whereas if the response is variability in a critical product dimension, we would seek a region of minimum variability[1].

In this section mentioned a number of studies that have been carried out in this area. Research by Hajihassani presented the investigate of factors affecting on mass construction industry by Latin Square design[2]. The goal of this research was to evaluation performance mass construction industry. Research by Rangriz and et al[3] done as performance evaluation of Iran Cement companies based on AHP and TOPSIS methods. The result was that Ardabil and Azar Shahr lime Cement Company earned the first ranking and also indicates that combined method is better than uncombined method. Hajihassani presented the relationship between Working Capital Management and profitability Iran Cement Industry [4]. The main objective of the study was to find whether financial ratios affect the performance of the Iranian companies in cement industry. This study empirically examines the relationship between working capital management and profitability by using data of 28 Iran cement companies. The secondary data of this study is collected from financial reports which is accepted in Tehran stock exchange for the period of six years from 2004-2009. The data was analyzed using the methods of correlation coefficient and multiple regression analysis. All the findings were tested at 0.01 and 0.05 level of significance. The return on investment is weak negatively correlated with CR, ITR. While, ROI is very weak positively correlated with CTR and LR. Some of the recent research suggests that the CTR and LR have a positive relation with ROI. Also, CTR and LR both have a negative impact on ROI. So, CR relationship is insignificant with ROI, the relationship is not decisive. Here is fundamental lose in the value of the R-squared. This result shows the significance of ITR in the model. However, there is a very weak relationship between working capital management and profitability in the specific context of cement industry in Iran[4].

2. Materials and Methods

The main objective of the study was whether financial ratios, time and company type effect on the performance of the Agricultural Machinery companies in Iran. This research is obtained Tehran Stock Exchange financial reports for years[5]. In this research used data of five Agricultural Machinery companies and the size sample was equal to the size society. Research method is descriptive and applications. Split-Plot design model used for investigate performance. In this research computed liquidity ratios obtained from the financial statements of the companies and used the Split-Plot design model and F-test perform.

2.1 Split-Plot Design Model

Split-plot designs were originally developed by Fisher (1925) for use in agricultural experiments. In this study, we may be unable to all randomize the order of the runs in some multifactor factorial experiments. In a generalization of the factorial design, these results called a Split-Plot design. A Split-Plot design can be as two experiments that combined or supper imposed on each other[6]. One experiment has the whole plot that it applied to the large experimental groups. The linear model for the Split-Plot design is

$$Q_{ijkm} = \mu + \tau_{fg} + \beta_g + (\tau\beta)_{fg} + \gamma_h + (\tau\gamma)_{fh} + (\beta\gamma)_{gh} + (\tau\beta\gamma)_{fgh} + \varepsilon_{fgh} \quad (1)$$

$$f = 1, 2, \ldots\ldots r \quad g = 1, 2, \ldots\ldots a \quad h = 1, 2, \ldots\ldots b$$

Where τ_f, β_g and $(\tau\beta)_{fg}$ expressed the whole plot and relation respectively to blocks, main factor A, and whole plot error and γ_h, $(\tau\gamma)_{fh}$, $(\beta\gamma)_{gh}$, $(\tau\beta\gamma)_{fgh}$ expressed the subplot and relation respectively to factor B, the replicates or blocks × B and AB interactions and blocks × AB. The Split-Plot design has an agricultural heritage, whit the whole plots usually being large areas of land and the subplots being smaller areas of land within the large areas[7]. Despite its agricultural basis, the Split-Plot design is useful in many scientific and industrial experiments. In these experimental settings, it is not unusual to find that some factors require large experimental units whereas other factors require small experimental units[8]. Alternatively,

we sometimes find that complete randomization is not feasible because it is more difficult to change the levels of some factors than others. The hard-to-vary factors are run in the subplots[1].

Formula for computing the sum of squares of the main effects are:

$$SS_{\tau} = \sum_{f}^{a} \frac{Q_{f...}^2}{abn} - \frac{Q_{....}^2}{abrn} \quad (2)$$

$$SS_{\gamma} = \sum_{f}^{a} \frac{Q_{..h.}^2}{arn} - \frac{Q_{....}^2}{abrn} \quad (3)$$

$$SS_{\tau\beta} = \sum_{f}^{a}\sum_{j}^{b} \frac{Q_{fg..}^2}{bn} - \frac{Q_{....}^2}{abrn} - SS_{\tau} - SS_{f} \quad (4)$$

$$SS_{\tau\gamma} = \sum_{f}^{a}\sum_{g}^{b} \frac{Q_{fh..}^2}{an} - \frac{Q_{....}^2}{abrn} - SS_{\tau} - SS_{\gamma} \quad (5)$$

$$SS_{\beta\gamma} = \sum_{f}^{a}\sum_{g}^{b} \frac{Q_{.gh.}^2}{rn} - \frac{Q_{....}^2}{abrn} - SS_{\beta} - SS_{\gamma} \quad (6)$$

$$SS_{\tau\beta\gamma} = \sum_{f}^{a}\sum_{g}^{b}\sum_{k}^{r} \frac{Q_{.fgh.}^2}{n} - \frac{Q_{....}^2}{abrn} - SS_{\beta} - SS_{\gamma} - SS_{\tau} - SS_{\beta\gamma} - SS_{\beta\tau} - SS_{\tau\gamma} \quad (7)$$

The variance analysis method is specified in Table 1. Simply a Split Plot experimental is block experimental that blocks are experimental units for subset of factorials. So there are two levels of experimental units. Blocks refer to the total design when experimental units within blocks called Split Plot design or Split Plot units or sub plots. Two levels of the experimental related to randomize two levels. Randomize determine the significance block to the total design[5].

2.2 Research Hypotheses

This study includes four hypotheses are as follows:

- Time affected the company's liquidity.
- Ratio type affected the company's liquidity.
- Company type affected the company's liquidity.
- Interaction ratio type and company type affected the company's liquidity.

Table 1. The variance analysis method[5]

F_0	MS	Degrees of freedom	SS	Factor
	$SS_{\tau}/(r-1)$	r – 1	SS_{τ}	T_f
$MS_{\beta}/MS_{\tau\beta}$	$SS_{\beta}/(a-1)$	a – 1	SS_{β}	β_g
	$SS_{\tau\beta}/(r-1)(a-1)$	(r – 1)(a – 1)	$SS_{\tau\beta}$	$(\tau\beta)_{fg}$
$MS_{\gamma}/MS_{\tau\gamma}$	$SS_{\gamma}/(b-1)$	b – 1	SS_{γ}	γ_h
	$SS_{\tau\gamma}/(r-1)(b-1)$	(r – 1)(b – 1)	$SS_{\tau\gamma}$	$(\tau\gamma)_{fh}$
$MS_{\beta\gamma}/MS_{\tau\beta\gamma}$	$SS_{\beta\gamma}/(a-1)(b-1)$	(a – 1)(b – 1)	$SS_{\beta\gamma}$	$(\beta\gamma)_{gh}$
	$SS_{\tau\beta\gamma}/(a-1)(b-1)(r-1)$	(a – 1)(b – 1) (r – 1)	$SS_{\tau\beta\gamma}$	$(\tau\beta\gamma)_{fgh}$

3. Result

We have calculated the liquidity ratios and the results are given in the Table 2.

In this model $(\tau\beta)_{ij}$ is still the whole plot error but the blocks × B and blocks × AB interactions have essentially been pooled with ε_{ijk} to form the subplot error. According to the results of Table 3, we see that ratios type and company type and Interaction ratio type and company type affected the company's liquidity. Then hypotheses 2, 3 and 4 can't be rejected at the 95% confidence level.

Table 2. Liquidity ratios

Time	Ratio Company	Current Ratio	Quick Ratio	Cash Ratio	Total
	Eshtad Iran	0.72	0.39	0.08	1.19
	Tractor	1.06	0.70	0.06	1.82
	Agricultural Services	1.98	0.95	0.22	3.15
	Combine	0.87	0.17	0.01	1.05
1389–90	Iran Tractor Machinery	1.05	0.40	0.02	1.47
Total		5.68	2.61	0.39	8.68
	Eshtad Iran	0.72	0.39	0.08	1.19
	Tractor	1.32	0.86	0.07	2.25
	Agricultural Services	2.42	1.32	0.27	4.01
1388–89	Combine	0.72	0.19	0.05	0.96
	Iran Tractor Machinery	1.01	0.38	0.02	1.41
Total		6.19	3.14	0.49	9.82
The sum total		11.87	5.75	0.88	18.5

Source: Tehran stock exchange.

Table 3. Split-Plot design model

P	F_0	MS	Degrees of freedom	SS	Factor
0.05	4	0.04	1	0.04	τ_i
0.05	303*	3.03	2	6.06	β_j
		0.01	2	0.02	$(\tau\beta)_{ij}$
0.05	24*	0.72	4	2.89	γ_k
		0.03	4	0.12	$(\tau\gamma)_{ik}$
0.05	15*	0.15	8	1.18	$(\beta\gamma)_{jk}$
		0.01	8	0.07	$(\tau\beta\gamma)_{ijk}$

*Is significant at %5 level.

4. Conclusion

In this research, the various liquidity ratios called plot that these can calling block. Plot terms inherited of the statistical material used in agriculture. By performing there experiment were told that the main effect of liquidity ratios is blended whit plot effect. If you choose one over the other terms of the relative change in the circumstances of this case, the change caused by the change in the ratio between appear. The main effect of this scheme is blended whit the effect of plot. When determined the ratio type then selected randomly of the three ratios between. Several companies can be called a plot element and for any company to imagine a section. Main plot element called Split Plot or sub plot. We from research conclude that liquidity Ratios and company type and interaction Ratio type and company type have significant effect on the liquidity of accepted in stock exchange Agricultural Machinery companies. In previous research mentioned in the literature review on the study effects of financial topics based on TOPSIS-AHP method and Latin Square design model and this study investigated the factors was conducted using a Split Plot design model. For future research is suggested that use taxonomy method in evaluation of the impact factorials on the liquidity of companies.

5. References

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