Using Ordinal Logistic Regression to Predict Terms of Payment in Shipbuilding Industry

Professor Rozga Ante, Ph.D.
Vukovarska 166
21000 Split, Croatia
rozga@efst.hr

Luetić Ante, Msc.Econ.
Split Shipyard
Put Supavla 21
21000 Split, Croatia
ante.luetic@st.htnet.hr

Introduction

In modern business purchasing function is becoming strategically important for the sustainability, competitiveness and prosperity of the enterprise which resulted in the conceptual shift from the internal activities of the strategic process that results in adding new value. Bearing in mind the fact that 60-70% of the costs the company controls the extended supply chain (Žibret, 2007; Ditman et al., 2010) enterprises should focus on those suppliers with whom the supply chain will be more competitive (Ha and Krishnan, 2008). Partnership with suppliers and development of long-term relationships are among the top five opportunities for cost savings (Jacoby, 2009). Emphasizes the importance of these relationships Lambert (2008) based it on the general theory of business process management and he has developed a processing approach to SCM and he states the managing relationships with suppliers as one among the eight most important.

The proper selection of suppliers should achieve practical and measurable economic effects of business enterprises:

• increasing the quality of supplied products which should have resulted in reducing the number of additional activities in the production process, and a smaller number of complaints in the post-sale period,

• increasing cost-saving of operations by reducing costs due to rationalization of dependent costs due to reduction of the number of suppliers,

• better cash-flow,

• development of mutual relations (company-supplier) in respect of quality, price, delivery terms and conditions of payment,

• mutual confidence due to the development of long-term partnership.

1. The Results of Ordinal Logistic Regression

When creating the basis for conducting this analysis one seeks to encompass the wider range of indicators and evaluators to reduce possible errors and potential subjectivity in the final outcome to an acceptable level.

We have chosen 77 most important suppliers regarding their total turnover in HRK (Croatian kunas).

We used ordinal logistic regression (referred as PLUM):

$$\ln \Theta_j = \alpha_j - \beta \cdot X$$

where:

$$\Theta_j = \frac{P(Y \le j)}{P(Y > j)}$$

or:

$$\Theta_j = \frac{P(Y \le j)}{1 - P(Y \le j)}$$

Dependent variable was delay of payment which was ordered in four groups: 0-60 days, 61-90 days, 91-120 days and over 120 days. Initially there were five predictors: ML are the most expensive materials whose potential suppliers are to be jointly defined (the shipowner and the shipyard) when they contracted the vessel, A consists of groups of direct materials for which we require technical processing of bids, N standard material, whose delivery date is within 60 days, ZM is standard material specified by requisition of materials whose delivery date is over 60 days, L is the material for which the range and quantity of sets limits on annual basis.

All predictors were dichotomous (yes or no). There were 77 most important suppliers considered.

The results of ordinal regression were as follows:

Table 1. Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	92,146			
Final	78,876	13,270	5	0,021

From the table above we could conclude that the model is good for prediction compared to the constant (significance level is less then 0,05).

Table 2. Goodness of Fit

	Chi-Square	df	Sig.
Pearson	41,222	34	0,184
Deviance	36,088	34	0,371

Both statistics were not significant so we could get a good prediction with our model.

Table 3. Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.
Threshold	[payment categ = 1]	-4,978	1,180	17,784	1	0,000
	[payment categ = 2]	-4,037	1,153	12,252	1	0,000
	[payment categ = 3]	-2,234	1,100	4,127	1	0,042
Location	[ML=1]	-,520	,561	,856	1	0,355
	[ML=2]	0[a]	.	.	0	.
	[A=1]	,056	,494	,013	1	0,911
	[A=2]	0[a]	.	.	0	.
	[ZM=1]	-3,524	1,135	9,645	1	0,002
	[ZM=2]	0[a]	.	.	0	.
	[N=1]	,522	,491	1,132	1	0,287
	[N=2]	0[a]	.	.	0	.
	[L=1]	-1,051	,591	3,165	1	0,075
	[L=2]	0[a]	.	.	0	.

a. This parameter is set to zero because it is redundant.

Reference category for payment was the last one (terms of payment over 120 days).

As we see from the table above, ZM variable is statistically significant (p = 0,002) and L variable could be also taken into considerations (p =0,075). These suppliers tend to be more delayed in payments.

REFERENCES

1. Hosmer, David W. and Lemeshow, Stanley (1989). Applied Logistic Regression. John Wiley & Sons, New York.

2. Bender, R. & Benner, A. (2000). Calculating Ordinal Regression Models in SAS and S-Plus. Biom. Journal 42, 677-699.

3. Chu, W., & Ghahramani, Z. (2005). Gaussian Processes for Ordinal Regression. Journal of Machine Learning Research, 6, 1019-1041.

4. Ditman, P., Slone, R. Mentzer, John T.(2010). Supply Chain Risk: It's Time to Measure it, Harvard Business Review, February 5, 2010.

5. Ha, Ho S., Krishnan R.(2008). A Hybrid Approach to supplier Selection for the Maintenance of a Competitive Supply Chain. Expert Systsems with Applications, 34., 2008.

6. Jacoby, D. (2009). Guide to Supply Chain Management. The Economist, London.

7. Lambert, D.M. ed. (2008). Supply Chain Management. 3rd Edition. Supply Chain Management Institute. Sarasota.

8. McCullagh, P. and Nelder (1989). Regression Models for Ordinal Data (with Discussion), Journal of the Royal Statistical Society – B 42(2), 109-142.

9. O'Connell, A. A. (2006). Logistic Regression Models for Ordinal Response Variables. Thousand Oaks: SAGE.

10. SPSS, Inc. (2002). Ordinal Regression Analysis. SPSS Advanced Models 10.0, Chicago, Il.

11. Žibret, B. (2007). Strateška nabava. MATE and ZŠEM. Zagreb, Croatia.

RÉSUMÉ

Nous avons analysé retard de paiement envers les fournisseurs dans le chantier naval "Brodosplit" à Split, en Croatie. Retard de paiement a été ordonné en quatre groupes: 0-60 jours, 61-90 jours, 91-120 jours et plus de 120 jours. Plusieurs facteurs prédictifs ont été proposés au début de l'étude. Ces variables sont de différents fournisseurs concernant le type de matériaux qu'ils offrent. Le premier était "ML", qui représente le matériau le plus cher dont les fournisseurs potentiels sont le chantier naval et l'armateur. Variable "A" est composé de matières directes, qui nécessitent une analyse complémentaire des offres. Variable "N", matériau standard qui est spécifiée par la liste des matériaux dont la durée de livraison est dans les 60 jours. Variable "ZM" est aussi une matière standard qui est spécifiée par la demande spéciale dont le délai de livraison est de plus de 60 jours. Variable "L" est la liste des matériaux dont l'assortiment et la quantité est limitée par catalogue au niveau annuel.

Retard de paiement a été traitée comme variable dépendante et nous avons utilisé la régression ordinale. Les prédicteurs étaient dichotomiques dont les modalités ont été «oui»ou «non» qui dépend de si le fournisseur est sur la liste ou non. La catégorie de référence pour la variable dépendante était la dernière a été: conditions de paiement de plus de 120 jours, soit le plus long. Application de régression ordinale nous avons trouvé deux variables est statistiquement significatif: ZM (p = 0,002) avec l'estimation de la régression coefficient de -3,524 et L (p = 0,075) avec l'estimation du coefficient de régression de -1,051.

Toutes les statistiques de régression ordinale étaient suffisantes et importante et ce modèle pourrait être considérée comme bonne pour la prédiction.