Decision making for Shipping Network based on Adaptive Cumulative Prospect Theory

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Abstract : This paper aims to propose optimal method to assess and cumulate the daily profit for liner shipping to support the shipping lines in making optimal decision with the highest average daily profit. This paper not only explains the actual calculated results align with decision-makers' behavior from concepts indicated in cumulative prospect theory but also contributes to an easy-to-apply method for liner shipping network predictability in and provides optimal decision-making is helpful for shipping managers for the best effective selection of the most appropriate alternative under uncertainties.

Key words: Decision-making; Shipping network, Cumulative prospect theory, Daily profit model, Expected utility theory

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		Introduction			
		Container of giving a stress of the second sec	arriers, faced w	ith challenges of increased costs, to seek gre to reroute to alternative ports of call is regar	eater profitability, ded as one of the
1 Internal without		efficient tre	atments		
I. Introduction		 Route choic 	ce models are e	ssential tools for decision-makers to identify	y the best strategies
2 Materia and Ottation		to improve	efficiency and e	nhance the network's overall sustainability a	as well as adapt to the
2. Motivation and Objectives		rapidly cha	nging the mariti	ime industry	
3. Modelling and Methodology		 Therefore, 1 combinatio prospect th 	this paper focus in factors influer neory (CPT)	es on suggesting an average daily profit moon noting shipping route choice behaviour by app	del with uncertain plying cumulative
4. Results and Condusions	<u>2</u>	 There are a 	few methods th	hat can be used to support decision-making,	, including cost-
		benefit ana	Ilysis (CBA), SW	OT analysis, multiple criteria decision-makin	ng (MCDM), Pareto
		analysis, A	nalytical Hierard	hy Processes, TOPSIS, Game theory, etc	
		 Programs a 	and algorithms a	are too complex and difficult for many decision	on-makers
					2
지동철 누직전입이든기만 신나 석도워크 도시공장 영법	1 (○) (1973년 1973년 1973년 2003년 한국양석명인(학회 순제학습(4회)	적충형 수직전설이 선사 네트워크 의/	기준기반 사결정 방법		2 💮 🔛
ಷಕ್ಷ® ಕಿಷಣ್ಣಿನಕ್ಕೆಗೆ ೭೫ ಕೆಲ್ಲಡ ವಿಗತಿತ ತಜೆ obvation and Objectives	1 (○) 한국왕석양 한학회 순계학습객회 2023년 한국양석양인학회 순계학습객회	직용형 가직전함으 순사 네트워크 위 Modeling and M	i 문기방 사결정 방법 Methodology		2 👾 🔛
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역동동 구역인용이란기간 선사 네트워크 의사결정 방법	2023년 한국항해항만학회 준계학술대
Nodeling and Methodology	
The prospect of an alternative	Value function of an outcome
$\begin{split} \mathbf{v}(a,p) &= \sum_{i=1}^{\nu} w(p_i)^* \mathbf{v}(a_i) \\ \mathbf{v}(a,p) &: \text{Prospect of an alternative} \\ w(p_i) &: \text{The weighting of the alternative of the probability.} \end{split}$	$v(a_i) = \begin{cases} a_i^{0.88} & a_i \ge 0 \\ -2.25(-a_i)^{0.88} & a_i < 0 \end{cases}$
• "The weighting of the probability function" $w^*(p) = p^7 / [p^7 + (1-p)^7]^{1/7} + \hat{\alpha}$ $w^-(p) = p^d / [p^d + (1-p)^d]^{1/d} + \hat{\beta}$	y≃0.61 (för gains); ∂≈0.69 (för lösses)
• The cumulative prospect of outcome $CPV(a)_{x} = \sum_{i=1}^{n} v(a_i)^* w^-(p_i) + \sum_{i=1}^{n} v(a_i)^* w^-(p_i)$ Losses are ranked from $i = 1$ to $i = m$ Gains are ranked from $i = m + 1$ to n $v(a_i)$: The value of outcome a'_i : An intervalue a'_i : An outcome	• The expected utility value of each alternative $EV(x) = \sum_{n=1}^{n} p_i * x_i$ Where: $\sum_{n=1}^{n} p_i = 1$ i : Alternative n : Number of alternative payoffs P_i : Providability of alternative x_i : Payoff of an alternative



Modeling and Methodology		
Total time spent for round voyage	$t^{iev} = \frac{\sum_{z \in \mathbb{Z}} d_z}{24^* v^{ai}} + 2^* \sum_{j=1}^n m_j^i + \sum_{j=1}^n \left(\frac{q_j^j}{r_j^j} + \frac{q_j^d}{r_j^d}\right)$	(3)
Portdues	$c_{j}^{\mu\nu} = c_{j}^{\mu\nu} + c_{j}^{\mu\nu} + c_{j}^{d\nu} + c_{j}^{h\nu} + c_{j}^{\mu\nu} + c_{j}^{\mu\nu} + c_{j}^{\sigma\nu} + c_{j}^{\sigma\nu} + c_{j}^{d} + c_{j}^{\ell} + c_{j}^{\ell}$	(4)
 Total running cost for a round voyage 	$c^{\prime rc} = c^{\prime tv} * t^{\prime cv}$	
Total bunker cost for a round voyage	$c^{bun} = s^{tcv} * f^{,b} * c^{,b} + t^{tcv} * f^{,o} * c^{,db}$	(5)
The total transshipment cost	$\sum_{z \in \mathcal{Z}} c_z^u = \sum_{z \in \mathcal{Z}} \left(q_z^u * u_z^u \right)$	(6)

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lotation	Description	Unit
C ^{pc}	Port charges on the leg z(z c Z) of round route	USD
$c_i^{h\nu}$	Inventory cost on the $legz(z \in Z)$ of round route	USD
C ^{CREM}	Commission fees on the leg $z(z \in Z)$	USD
c.br	Broker fees on the leg $z(x \in \mathbb{Z})$	USD
ech	Other cost of round route	USD
c^{dv}	Daily running cost of a vessel	USD
$c_j^{\sigma \tau}$	Anchorage dues in USD charged by port authorities for the use of anchorage facilities in port \boldsymbol{j}	USD
c_j^d	Custom declaration fees are charged by customs authorities for the use of the anchorage facilities in port ${\rm j}$	USD
e_j^{cl}	Clearance fees in port j	USD
r_j^{NR}	Tonnage due rate in port j	USD
F_j^{MN}	Navigation rate is calculated based on gross tonnage for each nautical mile	USD
d_j^{uv}	The distance in nautical mile when the vessel travels through navigable port j	Days
r_j^{ph}	Daily berth rate per day is charged per day for the use od berth	USD/TEU
d'''	Number of days in berth	Davs

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작용형 누직전함이론기반 선사 네트워크 의사결정 방법	2023년 한국방해방안학회 준계학	슬대회
deling and Methodology		
Total time spent for round voyage	$t^{iev} = \frac{\sum_{z \in \mathbb{Z}} d_z}{24^* v^{ai}} + 2^* \sum_{i=1}^n m_j^i + \sum_{z=1}^n \left(\frac{q_j^i}{r_i^i} + \frac{q_j^d}{r_i^d}\right)$	(3)

Fuel consumption during operation is assumed to be stabilized

- Assume that the freight rate is adjusted to increase or decrease together for all

Vessel is assumed to be parallel, to follow the same route, and to have a capacity that is adapted to transport demand
 Vessel is assumed to be parallel, to follow the same route, and to have a capacity that is adapted to transport demand

Assumptions

적용형 누적전함G 선사 네트워크 의/	(문기난 2023년 한국동 가글장 방법	해황만마회 춘계
deling and M	Aethodology	
Notation	Description	Unit
	Number of tugboat use to support the ship in entering and leaving the port j safety	USD
	Tugboat measurement of power in horse power	USD
	Mooring / unmooring price in port j	USD
	Quarantine, disinfection fees in port j	USD