



A Novel Pairwise Competitive Intensity Indicator for Airlines

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Measures of competitive intensity between airlines are compared, based on their flight supply strategies.

A Novel Pairwise Competitive Intensity Indicator for Airlines

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1 Introduction

- **Objective:** Study airline behavioral changes in response to competition.
- **Research Gap:** The intensity of competition is typically analyzed either as a static state or as a dynamic process of rivalry [1][2]. There is no comparable research in the literature.
- **Contributions:** Our pairwise measure can promptly reveal the competitive relationship between two parties.

2 Methods

The index can be constructed based on the following notions and information used:

- Correlation: Pearson's r ^(a).
- Distance: Distance between a pair of distributions ^(a).
- Similarity: Jaccard similarity coefficient ^(b); Cosine similarity ^(a).

(a) Flight frequency ;

(b) Binary representation (1 if presented on a route, 0 otherwise).

3 Data

- **Source:** Official Airline Guide (OAG).
- **Time period:** July-September 2023.
- **Scope:** Flights originating and terminating within the 41 Eurocontrol member states. **Top 50** operating airlines who have the most routes.

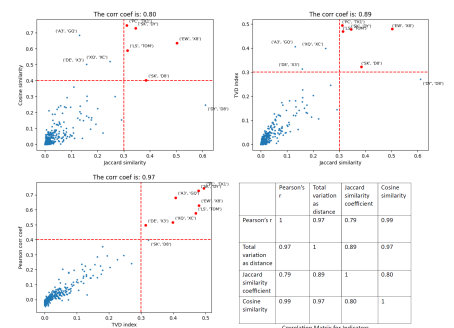
4 Results

- All proposed indices from the 'Method' section are highly correlated with each other. Additionally, they are consistent, as they share the same nine outliers, which have large values: (A3,GQ), (XQ,XC), (DE,X3), (DY,D8), (SK,D8), (LS,TOM), (SK,DY), (PC,TK1), (EW,X8).
- Results suggest a special collaboration pattern, since airlines with high index values often include parent companies and subsidiaries. This contrasts with the typical collaboration through complementary networks.
- Airlines tend to avoid competition, as the majority of the values for all the proposed indicators are small (most are <0.4).

5 Future works

- Account for asymmetry, weight route importance, and uncover competition's time evolution.
- Study airline group competition.

Extra figures



Letters a and b signify two airlines. Note that Pearson's r takes values in the range $[-1, 1]$, and all other indicators are in the interval $[0, 1]$, where 1 indicates the most intense competition and 0 indicates no competition.

Pearson's r :

$$\sigma^{(a,b)} = \frac{1}{|R|} \sum_{i=1}^n (f^a(r_i) - \bar{f}^a)(f^b(r_i) - \bar{f}^b)$$
$$I_1^{(a,b)} = \frac{\sigma^{(a,b)}}{\sqrt{\sigma^{(a,a)}} \sqrt{\sigma^{(b,b)}}}$$

(Total variation) Distance between distributions:

$$p^a(r_i) = \frac{f^a(r_i)}{f^a(R)}; p^b(r_i) = \frac{f^b(r_i)}{f^b(R)}$$
$$\text{TVD}(p^a, p^b) = \frac{1}{2} \sum_i |p^a(r_i) - p^b(r_i)|$$
$$I_2^{(a,b)} = 1 - \text{TVD}(p^a, p^b)$$

Jaccard similarity coefficient:

$$I_3^{(a,b)} = \frac{N(a \cap b)}{N(a \cup b)}$$

Cosine similarity:

$$I_4^{(a,b)} = \frac{\sum_i f^a(r_i) f^b(r_i)}{\sqrt{\sum_i f^a(r_i)^2} \cdot \sqrt{\sum_i f^b(r_i)^2}}$$

References

1. OECD (2021), *Methodologies to measure market competition*, OECD Competition Committee Issues Paper, <https://oe.cd/mmmc>
2. LIJESSEN, Mark G., NIJKAMP, Peter, et RIETVELD, Piet. *Measuring competition in civil aviation*. *Journal of Air Transport Management*, 2002, vol. 8, no 3, p. 189-197.



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