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A GENERALISED LINEAR MODEL FOR THE RISK ASSESSMENT OF CIVIL AIRCRAFT BOMB SABOTAGE ATTACK

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The risk of a civil aircraft being exploded by terror or criminal groups stays one of the largest concerns in aviation security nowadays. Significant efforts have been made by the industry to mitigate this risk by the introduction of advanced methods of passengers, baggage and cargo screening. Nevertheless, several successful and failed attacks on civil aircraft were registered in recent years. In this paper we argue that it is possible to predict the risk of a bomb attack based on historical data. We show that security and geo-political data can inform aa Generalized Linear Model that estimates a likelihood of bombing incident on a civil aircraft in a given country.

Keywords: aviation bombing, security, risk, machine learning, generalized linear model.

1. Introduction

With over 90 cases of civil aircraft bomb sabotage and more than 2400 casualties of these attacks registered since 1949, aircraft bombing is one of the key risks faced by the aviation industry (Jenkins, 1998)(Network, 2022).

Aviation industry has gradually introduced mitigating actions in an attempt to prevent bomb threat nevertheless terror groups continue attempts to attack civil aircraft. The most recent examples of aircraft bomb sabotage incidents include explosion of Somalian Daalo Airlines aircraft in 2016 and Russian MetroJet Airlines aircraft in Egypt in 2015 (Network, 2022). Also, several attempts of aircraft explosion were thwarted, the most known of which were the explosion attempts of two cargo aircrafts bound to US airports in 2010 (cnn.com, 2010) and the foiling of the plot to explode a passenger aircraft enroute from Australia to UAE in 2017 (bbc.com, 2019).

It is understood that aircraft security risk is influenced by the security situation of the country and of the country economic status or geopolitical factors (Bukhman, Brito, & Sung, 2022). In this paper we propose a method to quantify the risk of aircraft bombing based on these factors.

2. Methodology

In our previous research we have identified that *type of conflict* in a given country (*Conflict_Type*), intensity of a conflict (*Conflict_Intensity*), *GDP per capita* in thousands of US dollars (*GDP_PC_1000*) influence aviation security, hence we use these factors as independent variables (Bukhman, Brito, & Sung, 2022). As bomb sabotage is linked with terror or criminal activities, we introduce the variable *target of the threat* (*Target_Of_Threat*) to define what was the most contributing factor for the attack – threat at the country of origin, destination or other threat. One more independent variable that was identified as significant is *nature* of the flight – a type of the flight (scheduled, non-

scheduled, cargo, military etc.) in accordance with ICAO classification of flights (*Nature_Of_Flight*).

In our previous research we have demonstrated that generalized linear model can be used to estimate the likelihood of an event of aircraft downing by surface to air missiles, in this study we propose to use this methodology to estimate the probability of bombing incident.

3. Dataset

We use Aviation Safety Network dataset (Network, 2022) to capture bomb sabotage incidents and their descriptions given in the global terror database (Terrorism, 2022). In addition we use the World Bank datasets for GDP per capita per country per year (Bank, 2020) and aircraft departures per country per year necessary to calculate the probability of an incident (Bank, 2019). Merging all datasets and removing records with missing data (e.g., GDP data was collected by the World Bank only from 1960) results in 59 datapoints.

4. Modelling result

We run the Generalized Linear Model with dependent variable *P_Attack* and independent variables provided in section2. The dataset is divided to training and test dataset for out of sample validation in 80/20 proportion.

Table 1. Parameter estimates – generalized linear model

	Hypothesis Test		
Parameter	Wald Chi-Square	df	Sig.
(Intercept)	136.207	1	.000
[intensity_level=1]	2.231	1	.135
[intensity_level=2]	1.126	1	.289
[intensity_level=3]	.	.	.
[type_of_conflict=2]	.480	1	.489
[type_of_conflict=3]	.249	1	.618
[type_of_conflict=4]	5.559	1	.018
[type_of_conflict=5]	.	.	.
[Nature_Of_Flt=1]	3.082	1	.079
[Nature_Of_Flt=6]	.	.	.
[Target of threat=1]	5.099	1	.024
[Target of threat=2]	5.401	1	.020
[Target of threat=3]	.	.	.
GDP_PC_1000	29.745	1	.000
(Scale)			

The results of modelling demonstrate that variables *Target_Of_Threat, GDP_PC_1000 and Nature_Of_Flight* are significant for predicting he probability of bombing. The Type_Of_Conflict is significant only in case of internationalized internal conflict and conflict intensity has low significance in case of bombing incidents.

To assess whether there is any significant difference between the predicted and observed values, let us assume we test the null hypothesis that there is no significant difference between observed and predicted values of *P_Attack* using Chi Square test. We identify that p-value is close to 1, confirming that the null hypothesis – that there is no significant difference between observed and predicted values of probability of attack.

5. Conclusions

The proposed methodology demonstrated a good model fit, hence it can be employed to improve existing risk assessment approaches as independent method or in combination with other existing risk assessment methods.

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