Study Takeoffs and Landings at Airport in Santa Maria Aracaju (Brazil)

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Abstract
This study aims to test whether there were significant differences at the 5% level, between the average delay takeoffs and landings, the airlines and identify which of these companies had significant differences. Data were collected from takeoffs and landings, the months of January and April 2012, the airlines operating at the airport in Santa Maria Aracaju (Brazil) and held the ANOVA and multiple comparison test. The results indicated that the average delay in departures were higher. Although January is considered high season and April, low season, the results indicated no differences between the mean delays. The highest average delays of both landings as takeoffs occur in the large airlines.
Key-words: Landings delays, takeoffs delays, Airport.

1. Introduction

The Santa Maria Airport, located in Aracaju/SE, meets daily, six thousand people circulate through the airport terminal, totaling nineteen flights daily and a monthly average of sixty thousand passengers (INFRAERO, 2012).

According to ASN (2011), is scheduled for the second half of 2012 a reform of the airport, which is reaching its saturation capacity. Therefore, it is necessary to study the period of time that passengers remain in the airport lounge or in the halls of shipments awaiting their flight schedules, considering the delays in takeoffs and landings in each of the airlines that operate there.

Therefore, we analyzed the months of January and April 2012, through the analysis of variance and subsequently by the Tukey test in order to verify the issue of delays from the flights that land and / or take off at the airport, at a level statistical significance (5%).

This paper is relevant to be presented at the conference by treating science and modeling series that contributed to improvements of the airport that will be included in the period of the Olympics 2016.

2. Analysis of Variance (ANOVA)

According Anjos (2009) an analysis of variance to verify whether there is a significant difference between the mean and the factors exert influence on some dependent variable. There are two methods to calculate the variance: within groups (SSreg) and the variance of the mean (MSres).

Table 1 – ANOVA.

Source	SS[1]	df[2]	MS[3]	F[4]
Regression	SSreg	K – 1	MSreg	MSreg/MSres
Residuals	SSres	N-K	MSres	
Total	SStotal	N-1		

Legend: 1-Sum of Square, 2-Degrees of freedom, 3-Mean Square, 4-Distribution F

The null hypothesis is rejected when calculated when F is greater than the tabulated value. If the test F indicate significant differences between means, and the levels are random, there is interest in identifying the components of the estimation variance. The value indicates the total variability found between groups, indicating whether or not it is considered significant.

3. Results

The data were collected in INFRAERO located at Santa Maria airport in Aracaju, the observations are related to landing and takeoffs in the period of January and April 2012.

Table 2 – ANOVA (January)

Source		SS[1]	df[2]	MS[3]	F[4]	P-v
Delays during landing.	Regression	241,390	4	60,348	6,457	0,00
	Residuals	6243,130	668	9,346		
	Total	6484,520	672			
Delays in departures	Regression	733,431	4	183,358	16,631	0,00
	Residuals	7353,556	667	11,025		
	Total	8086,987	671			

Table 3 – ANOVA (April)

Source		SS[1]	df[2]	MS[3]	F[4]	P-v
Delays during	Regression	172,410	4	43,103	7,503	,00

	Residuals	3768,658	656	5,745		
	Total	3941,068	660			
Delays in departures	Regression	920,389	4	230,097	7,548	0,00
	Residuals	19997,085	656	30,483		
	Total	20917,474	660			

The Tables 2 and 3 show that there is evidence of a significant difference between the treatment means at the 5% level.

Table 4 shows the average delay for each airline landing in January 2012.

Table 4 – Delay landings (January)

Airline	Number of landings	Mean Delay for Subset at 5%	
		1	2
TRIP	184	2,90	
OCEANAIR	60	3,72	3,72
TAM	186	4,02	4,02
AZUL	62		4,21
GOL	181		4,44

Legend: 1- Values obtained by the Tukey test.

The longest delay recorded in the landing is the airline GOL with an average of 4.44 minutes. The TRIP presents the average delay in landing lowest, 2.90 minutes.

Table 5 presents the data in January 2012. The longest delay recorded at takeoff is the airline GOL which has an average of 8.31 minutes, and the shortest delay was 5.93 minutes, the airline TRIP.

Table 5 – Delayed departures (January)

Airline	Number of departures	Mean Delay for Subset at 5%		
		1	2	3
TRIP	184	5,93		
OCEANAIR	60	6,55	6,55	
AZUL	62		7,73	7,73
TAM	186			8,26
GOL	180			8,31

Legend: 1- Values obtained by the Tukey test.

Table 6 – Delay landings (April)

Airline	Number of landings	Mean Delay for Subset at 5%.		
		1	2	3
TRIP	220	3,12		
OCEANAIR	57	3,44	3,44	
TAM	180	3,64	3,64	3,64
AZUL	59		4,24	4,24
GOL	145			4,43

Legend: 1- Values obtained by the Tukey test.

Table 6 presents the data in April 2012. The longest delay recorded in the landing is the company's GOL with an average of 4.43 minutes, and the shortest delay was 3.12 minutes, the airline TRIP. It appears that GOL, AZUL, TAM have the same average delay in landing, other than January.

Table 7 presents the data in April 2012. The longest delay recorded at takeoff is the airline TAM with an average of 8.73 minutes. The airlines GOL, TAM and AZUL have same average delay in departures, similar to January. The TRIP, in turn, presents the average delay lower takeoff, of 5.86 minutes.

Table 7 – Delayed departures (April)

Airline	Number of departures	Mean Delay for Subset at 5%.	
		1	2
TRIP	220	5,86	
OCEANAIR	57	6,42	
AZUL	59	7,73	7,73
GOL	145	7,86	7,86
TAM	180		8,73

Legend: 1- Values obtained by the Tukey test.

5. Conclusion

It is concluded that there are significant differences between the mean delays in both the landings as takeoffs, among the airlines operating in the Santa Maria Airport in Aracaju (Brazil). The average delay in takeoffs are larger, possibly due to a larger amount of factors that may cause delays, such as waiting for connections, maintenance of the aircraft. Although January is considered the high season, unlike the month of April, there was a similarity between the mean delays. It is seen that the delays encountered in this airport does not affect the normal activities of those who need to move using this airport because by Brazilian standards The companies may have considered normal delays at most two hours. So Santa Maria airport is prepared to meet the increased flow of tourists during the Olympics 2016.

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