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Examining the Relationship between an Aging Workforce and Logistics Performance Indicators

Daniel Parkhill

EXAMINING THE RELATIONSHIP BETWEEN AN AGING WORKFORCE AND LOGISTICS PERFORMANCE INDICATORS

THESIS

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Abstract

In the United States, 10,000 baby boomers (born 1946-1964) turn 65 every day. This will continue until the year 2030. The subsequent generation born between 1965 and 1976 is significantly smaller, colloquially referred to as the baby bust. As a result, this causes a talent shortage as Baby Boomers retire, leaving a workforce gap which the subsequent generation is not large enough to fill. This issue also has been recognized as a potential problem in the logistics community of the United States Air Force. The purpose of this study is to examine the impact of workers' age on key logistics performance indicators (LPIs) such as aircraft availability, product flow days, and production hours. This study finds that significant relationships exist between mean employee age and certain LPIs.

To My Wife

Acknowledgments

First and foremost, I wish to thank my wife for her support and patience. I wouldn't be where I am--or who I am--without her unwavering confidence in me.

I would also like to express my sincere appreciation to my research advisor, Dr. Seong-Jong Joo, for his guidance and support throughout the course of this research. Your insight and experience was certainly appreciated. I would also like to thank Lesley E. Glover-Daniely and Andrew P. Beall, without whom it would have been impossible to collect the personnel and aircraft data necessary for the successful completion of this project.

Daniel E. Parkhill

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EXAMINING THE RELATIONSHIP BETWEEN AN AGING WORKFORCE AND LOGISTICS PERFORMANCE INDICATORS

I. Introduction

General Issue

In the United States, 10,000 baby boomers (born 1946-1964) turn 65 every day, and this is expected to continue until the year 2030 (Hirsch, 2017). The subsequent generation born between 1965-1976 is significantly smaller, colloquially referred to as the baby bust. As a result, this causes a talent shortage as Baby Boomers retire, leaving a workforce gap which the subsequent generation is not large enough to fill.

The U.S. General Accounting Office (2001) reported that there were 18.4 million workers aged 55 or older in the workforce. This number was projected to grow significantly in the subsequent 15 years, reaching an estimated 31.9 million by 2015. This increase was expected to be a result of the aging baby boom generation and a trend of prolonged workforce participation among its older members. Confirming the U.S. General Accounting Offices' predictions, the U.S. Bureau of Labor Statistics (2015) reported that this number had grown to 33.4 million and continued its upward trend to 36 million at the close of 2021.

The U.S. Bureau of Labor Statistics has limited historical data available due to changes in the occupational and industry classification systems that affect comparability over time. Using their available data, however, a comparison for the U.S. workforce of 2011 against 2021 is shown in Table 1.

Table 1. 2011 and 2021 U.S. Workforce Age Comparison

Workforce Age Group	2011		2021		10 year Change
	Total Employed (thousands)	Percent of Total	Total Employed (thousands)	Percent of Total	
16 to 19 Years:	4,327	3.1%	5,266	3.5%	0.4%
20 to 24 Years:	13,036	9.3%	13,409	8.8%	-0.5%
25 to 34 Years:	30,537	21.8%	34,578	22.7%	0.8%
35 to 44 Years	30,270	21.6%	32,738	21.5%	-0.2%
45 to 54 Years:	32,867	23.5%	30,544	20.0%	-3.5%
55+ Years:	28,833	20.6%	36,039	23.6%	3.0%
Totals:	139,870		152,574		

This comparison shows that the U.S. labor workforce is experiencing an age-demographic shift. The 55 and older age group experienced a three percent increase over the past 10 years while the other age brackets experienced declines or remained relatively stable.

Problem Statement

In 2020, the Warner Robins Air Logistics Complex (WR-ALC) observed a potential pattern of changes in production metrics that led them to questions whether there may be a relationship between the aging workforce and certain Logistics Performance Indicators (LPIs). If Air Force logistics are to project, protect, and sustain the force, they must maintain situational awareness of these potential changing conditions.

Research Objectives

The goal of this research is focused on identifying if a relationship exists between the mean employee age at the WR-ALC and the following LPIs: Aircraft Availability,

Product Flow Days, and Production Hours. This research will examine the strength of these relationships and their statistical significance.

Investigative Questions

IQ1: Is there a statistically significant relationship between Mean Employee Age and Aircraft Availability within the 561 Aircraft Maintenance Squadron (561 AMXS).

IQ2: Is there a statistically significant relationship between Mean Employee Age and Product Flow Days within the 561 AMXS.

IQ3: Is there a statistically significant relationship between Mean Employee Age and Production Hours within the 561 AMXS.

Limitations

At the request of the WR-ALC Business Operations department, this analysis has been limited to the 561 AMXS within the WR-ALC. If a statistically significant relationship exists, any applications of this research will need to be done so cautiously. Using the models created here as a forecasting tool may not reflect observed values if there is a substantial amount of variability left unaccounted for.

Approach/Methodology

All necessary data was collected and used to create a simple linear regression model of mean employee age (independent variable) against three LPIs (dependent variables; one for each problem statement). These models were analyzed using the linear regression techniques outlined in Chapter III. Methodology.

II. Literature Review

Chapter Overview

Chapter 2 presents an overview of previous research related to the study of workforce age and its effects on physical and cognitive performance. Calzavara et al. (2020) performed a comprehensive systematic review of research related to this subject and found that the topic of an aging workforce should not only attract interest from institutions, economists, and governments, but also from practitioners and researchers focused on production systems. Their principal reasoning for this assertion was that the mean retirement age had become higher in many countries while the mean birthrate had declined. This chapter examines research related to shifts in the workforce age demographics, physical performance related to age, and cognitive performance related to age.

Research Related to Workforce Demographics Shifts

The European Commission (EC) published a report (European Commission (EC), 2017) which reviewed the demographic developments and expected long term impacts to the demographic structure of 28 European countries. While this research focused on effects to pensions, healthcare, and long-term care, it also shed more light on global changes to workforce age demographics. It found that the European Union population was expected to expand from 507.2 million in 2013, to 522.8 million in 2060. The percentage of seniors (60 years and older) were expected to grow by 10 percent while the working population (16 years and older) was expected to drop by 9.4 percent. Their analysis was extended to the United States where they found people over the age of 65

comprised approximately 18.6 percent of the working population in 2016 and this was expected to grow by 0.6 percent per year until 2026. When they Extended their analysis to Japan, they found that more than 25 percent of the working population was age 65 or older in 2014, and this was expected to grow to 40 percent by 2060.

Research Related to Workforce Age and Performance

Schwerha (2004) examined the cognitive analysis of older workers. She studied the impact of age when confronted with auditory and visual distractors in four different phases of learning such as trial time, trials needed to complete an experiment, the number of times an instructional video was watched, and the number of trial errors. It was determined that age was found to be a significant factor only in the total number of trials; subjects aged between 51 and 65 took 31 percent more trials than younger subjects to adequately learn the process. The final conclusion, however, was that age should not be the sole indicator used to estimate an employee's ability to learn. During the learning process, it was noted that older employees took a more conservative approach to watching training videos than their younger counterparts. They preferred to watch the videos multiple times to ensure they were accomplishing the tasks correctly. The research ultimately recommended that measures be put into place whereby auditory and visual distractors could be minimized and that reinforcement training be offered as needed to help improve spatial abilities for older employees.

Wiker et al. (2009) expanded upon this research by conducting a similar study examining the impact of age on manual tasks when confronted with visual and auditory distractors. This research found that the introduction of distractors produced a material

decline in the ability of 50 to 65 year-old employees to learn manual assembly tasks. However, if the same employees had high spatial reasoning capabilities, they were able to perform competitively with their younger counterparts. Their conclusion suggested that selecting employees based on chronological age was less effective than selecting them based on their spatial reasoning abilities. They were able to show that higher spatial reasoning abilities resulted in faster learning and assembly time. Additionally, for employees with lower spatial reasoning abilities, the removal of auditory and visual distractors was beneficial.

Moraru et al. (2017) conducted a case study on the aging workforce at a Romanian manufacturing company whose mean employee age was 54. Their study analyzed 25 years of data on demographics, labor conditions, staffing resources, and how the company had adapted to economic and technological changes. They found that this particular company, recognizing the shift in age demographics over the years, had developed mentoring activities and processes to properly address them. The education and experience gaps between generations in this company had been complemented by a system of mentorship whereby experienced workers train younger workers to maintain the continuity of efficient processes. This company had identified the typical obstacles related to education and experience gaps and had implemented mentorship and training programs for both young and old employees. This company may have employed older workers, but they did not employ unskilled workers. This research concluded that though physical and cognitive decline might progress with age, it did not necessarily affect the performance and productivity of this company.

III. Methodology

Chapter Overview

This chapter describes data and methods employed in this study. Two types of data were obtained: personnel data for the independent variable and aircraft production data for dependent variables. All data pertains to the targeted 561 AMXS. Personnel data contained the mean age of all employees, and aircraft production data contained Aircraft Availability, Flow Days, and Production Hours. Linear regression was then used to test the relationship between the independent variable and each of the dependent variables.

Data Description and Collection

Personnel data was gathered from the Human Resource Department, 78th Force Support Squadron, Robins Air Force Base (AFB), Georgia (GA). Aircraft production data was gathered from the Maintenance Workload Department, Warner Robins Air Logistics Complex, GA. The data was consolidated, organized, and pared down to the largest usable set for the period from October 2012 to August 2021.

Mean Employee Age

Monthly employee age data was provided in an Excel document dating from October 2012 to August 2021. This data showed every employee without personal identifiable information at the work center, which allowed the calculation of mean employee age at the end of each month. This data was then transferred to a master data document for aggregation into a table where it was prepared for conducting linear regression analysis. This data can be found in Appendix B.

Aircraft Availability

Aircraft Availability data in monthly intervals was provided in an Excel document dating from October 2012 to August 2021. This data shows the aircraft availability rate in percent and the local standards for availability rates in percent. The local standard for availability varies over time, so an additional column was added to calculate the Squadron's "AA Performance Indicator." This is a simple percent of deviation from the local standard. Positive values of the AA Performance indicator represent actual aircraft availability above the local standard, and negative values represent actual aircraft availability below the standard like the following example:

$$AA\ Performance\ Indicator = \left(\frac{Actual\ Availability}{Availability\ Standard} - 1\right) * 100$$

Actual Availability: 61.83 percent

Availability Standard: 61.00 percent

AA Performance Ind: $\left(\frac{0.6183}{0.6100} - 1\right) * 100 = 1.36\ percent$

This result means that the Squadrons' actual availability exceeds the local availability standard by 1.36 percent. Similarly, a negative value would indicate that the unit's actual availability underperformed by that percent. This method provides a standardized metric by which we can analyze each month without extreme worry of variation due to changes in the local standard. It is a measurement of the unit's ability to meet the local standard, in any given month, regardless of an actual standard value.

This data was further delineated by Mission Design Series (MDS) for F015C, F015E, and F015D. Since this research is concerned with the overall output of the Squadron, all values pertaining to a particular period are used to create a singular mean

output. This data was then transferred to a master data document for aggregation and linear regression analysis. This data can be found in Appendix C.

Product Flow Days

The data for Product Flow Days in monthly intervals was provided in an Excel document dating from October 2012 to August 2021. This document showed the actual product flow days as well as the scheduled product flow days. The scheduled flow days varies over time, so an additional column was added to calculate the Squadron's "FD Performance Indicator". This is a simple percent of deviation from the scheduled flow days. Positive values of the FD Performance Indicator represent actual flow days above the scheduled flow days, and negative values represent actual flow days below the scheduled flow days like the following example:

$$FD\ Performance\ Indicator = \left(\frac{Actual\ Flow\ Days}{Scheduled\ Flow\ Days}\right) - 1 * 100$$

Actual Flow Days: 408

Scheduled Flow Days: 433

FD Performance Ind: $\left(\frac{408}{433} - 1\right) * 100 = -5.77\ percent$

This result means that the Squadron's actual flow days are 5.77 percent lower than the scheduled flow days. Similarly, a positive value would indicate that the Squadron's actual flow days exceeded the scheduled flow days by that percent.

This data was further delineated by MDS for F015C, F015E, and F015D. Since this research is concerned with the overall output of the Squadron, all values pertaining to a particular period are used to create a singular mean output. This data was then

transferred to a master data document for aggregation and linear regression analysis. This data can be found in Appendix D.

Production Hours

Monthly data for Production Hours was provided in an Excel document dating from October 2012 to August 2021. This data shows the actual production hours as well as the target production hours. The target production hours vary over time, so an additional column was added to calculate the Squadron's "PH Performance Indicator". This is a simple percent of deviation from the target production hours. Positive values of the PH Performance Indicator represent actual production hours above the target production hours, and negative values represent actual production hours below the target production hours like the following example:

$$PH\ Performance\ Indicator = \left(\frac{Actual\ Production\ Hours}{Target\ Production\ Hours} - 1\right) * 100$$

Actual Production Hours: 38,395.9

PH Target Hours: 42,826.2

PH Performance Ind: $\left(\frac{38{,}395.9}{42{,}826.2} - 1\right) * 100 = -10.34\ percent$

This result indicates that the Squadron's actual production hours are 10.34 percent lower than the target production hours. Similarly, a positive value would indicate that the Squadron's actual production hours exceeded the target production hours by that percent. This data was then transferred to a master data document for aggregation and linear regression analysis. This data can be found in Appendix E.

Consolidated Variable Review

Table 2 and Table 3 display a review of relevant information pertaining to each of the independent and dependent variables. These tables are provided for reference.

Table 2. LPI Descriptive Statistics

	Mean Age	AA Performance Indicator	PH Performance Indicator	FD Performance Indicator
Mean	44.532	-0.0741	-0.0922	0.1520
Standard Deviation	2.772	0.0713	0.2024	0.2215
Min	36.855	-0.2698	-0.6499	-0.1073
Max	54.467	0.1001	0.3117	0.7219

Table 3. LPI Value Descriptions

	AA Performance Indicator	*PH Performance Indicator*	*FD Performance Indicator*
Positive Values	Positive Deviation of Actual AA from AA Standard	Positive Deviation of Actual PH from Target PH	Positive Deviation of Actual FD from Scheduled FD
Negative Values	Negative Deviation of Actual AA from AA Standard	Negative Deviation of Actual PH from Target PH	Negative Deviation of Actual FD from Scheduled FD

Linear Regression

The methodology employed is simple linear regression. A linear regression model was created for each of the three dependent variables against the independent variable. These models assume that the relationship between the dependent variable and the independent variables can be estimated by a straight line which can be expressed with the following equation (Bowerman et al., 2005:85):

$$y = \beta_0 + \beta_1 x_1 + \varepsilon \quad (1)$$

In this case, the parameter β_0 represents the y-intercept and the parameter β_1 represents the slope of the equation. In some instances, the relationship between the dependent variable and the independent variable could be better estimated with a nonlinear line with a quadratic term. In this case, a quadratic regression model can be expressed with the following equation:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_1^2 + \varepsilon \quad (2)$$

In this case, the parameter β_0 represents the y-intercept of the parabola, the parameter β_1 represents the shift parameter of the parabola, and the parameter β_2 represents the rate of curvature of the parabola. Although the quadratic model employs a squared term (x^2), it is still a simple linear regression model because the mean value of y (through the expression $\beta_0 + \beta_1 x + \beta_2 x_1^2$) is still expressed as a linear function of the β_0, β_1, and β_2 parameters.

The adjusted coefficient of determination ($\bar{R}^2$) value for each model was reviewed to determine how much of the variation within the model is accounted for. This value represents the explained variation divided by the total variation. The significance level for each model was reviewed to determine whether they indicate statistically significant results. For this analysis, a significance value of $\alpha = 0.05$ was used. Any value smaller than 0.05 will be interpreted to mean that there is strong evidence that the regression relationship is significant. Parameter estimates and confidence intervals were reviewed and analyzed, as well as three regression assumptions to ensure they were not violated (Bowerman et al., 2005:238-240). These assumptions are:

1. Constant variance: The spread of residuals around 0 does not change much as the horizontal plot increases.

2. Correct functional form: There is no obvious pattern in the residual plots that would suggest a more appropriate model such as dips, curves, alternations, etc.
3. Normality: The error terms have a normal distribution and appear reasonably bell-shaped.

It is important to note that when two variables are shown to be correlated, we should take caution before concluding that they must, in some way, influence each other (Leedy & Ormrod, 2016:139). Regression analysis alone is not sufficient to determine a causal relationship. This research examines the relationships between variables without considering a causal relationship.

IV. Results and Discussion

Chapter Overview

This chapter will examine the results of three linear regression models. These models are: Aircraft Availability (y) against Mean Employee Age (x), Flow Days (y) against Mean Employee Age (x), and Production Hours (y) against Mean Employee Age (x). It also reviews the adjusted coefficients of determination ($\bar{R}^2$), significance levels, parameter estimates, confidence intervals, and residual plots.

Results of Regression Models

Model 1: Aircraft Availability (y) against Mean Employee Age (x)

Model 1 began with a scatterplot of Aircraft Availability (y) against Mean Employee Age (x) to look for patterns. Fitting a linear line, this plot in Figure 1 does not appear graphically to have a strong positive or negative linear pattern--that is, it does not appear to be a strong example of a dependent variable increasing or decreasing linearly as the independent variable increases or decreases.

Superimposing a quadratic fit in Figure 1 over this same scatterplot shows that it also does not appear graphically to have a strong relationship. When two models were compared via regression, however, it was found that the quadratic relationship was a better fit. Therefore, it seems reasonable to attempt to relate y to x using a quadratic model (Bowerman et al., 2005:169).

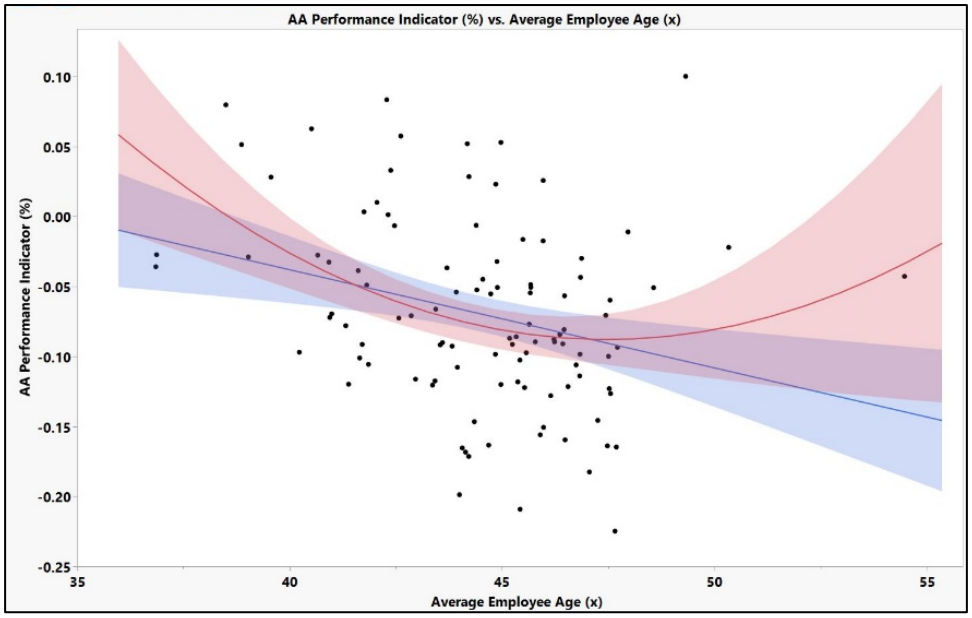

Figure 1. A Scatterplot for AA Performance Indicator (y) against Mean Employee Age (x)

After understanding these relationships, an additional column was added to the data set for the squared term (x^2), to reflect the rate of curvature for this parabola. The $\bar{R}^2$ for this model was 0.1195. The variability of the dependent variable or AA Performance Indicator in the model was explained by 11.95 percent. The resulting regression model is: $\hat{y} = 2.4074 - 0.1051x_1 + 0.0011x_1^2$. The overall model fit with F statistics is shown in Table 4.

Table 4. AA Performance Indicator Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.0633	0.0317	7.9863
Error	101	0.4004	0.0040	Prob > F
C. Total	103	0.4637		0.0006

As shown in Table 4, the overall fit for this model is significant at alpha = 0.01.

Mean Employee Age (x) Parameter β_1 Analysis

The significance level for the parameter (β_1) of Mean Employee Age (x) is 0.0101, which indicates strong evidence that x is significantly related to y, as shown in Table 5.

Table 5. AA Performance Indicator Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	2.4074	0.8883	2.7100	0.0079	0.6452	4.1696
Mean Employee Age (x)	-0.1051	0.0401	-2.6200	0.0101	-0.1846	-0.0256
Mean Employee Age Squared (x^2)	0.0011	0.0005	2.4500	0.0159	0.0002	0.0020

The significance level represents a 1.01 percent chance that this conclusion is incorrect (Type-I error), which means that it is extremely likely that the mean value of the dependent variable (y) changes as the independent variable (x) changes.

The parameter estimate for β_1 of the independent variable x in Table 5 is -0.1051. This means that for every unit-level increase of x (Mean Employee Age), the mean value of y will decrease by 0.0151. The parameter estimate for β_2 of the squared independent variable x^2 is 0.0011. This means that for every unit-level increase of x^2 (Mean Employee Age squared), the mean value of y will increase by 0.0011. Since this is a quadratic model, it is important to recognize that the β_1 and β_2 parameters need to be considered together when examining the model.

The 95 percent confidence intervals for the parameter estimate for β_1 of the independent variable x in Table 5 is [-0.1846, -0.0256]. This can be understood to mean that we are 95 percent confident that for any unit-level change in x, the mean value of y will increment/decrement (as appropriate) by a value within this range.

Mean Employee Age Squared (x^2) Parameter β_2 Analysis

The significance level for the Mean Employee Age Squared (x^2) parameter (β_2) in Table 5 is 0.0159, which indicates strong evidence that x^2 is significantly related to y. The significance level represents a 1.59 percent chance that this conclusion is incorrect (Type-I error), which means that it is extremely likely that the mean value of the dependent variable (y) changes as the independent variable (x^2) changes.

The parameter estimate for β_1 of the independent variable x in Table 5 is -0.1051. This means that for every unit-level increase of x (Mean Employee Age), the mean value of y will decrease by 0.0151. The parameter estimate for β_2 of the squared independent variable x^2 is 0.0011. This means that for every unit-level increase of x^2 (Mean Employee Age squared), the mean value of y will increase by 0.0011. Since this is a quadratic model, it is important to recognize that the β_1 and β_2 parameters need to be considered together when examining the model.

The 95 percent confidence intervals for the parameter estimate for β_2 of the independent variable x is [0.0002, 0.0020]. This can be understood to mean that we are 95 percent confident that for any unit-level change in x^2, the mean value of y will increment/decrement (as appropriate) by a number within this range.

Residual Analysis

The constant variance assumption was examined using the plot of residuals against mean employee age (x) in Figure 2 and the plot of residuals against predicted ($\hat{y}$) in Figure 3. The spread of residuals around 0 does not change much as the horizontal plot increases, but it does appear to be more heavily concentrated to the left side in the plot of

residuals against predicted ($\hat{y}$). This model does appear to be slightly unbalanced. If violated, however, it would be suggested that caution be exercised when using this model to make statistical inferences.

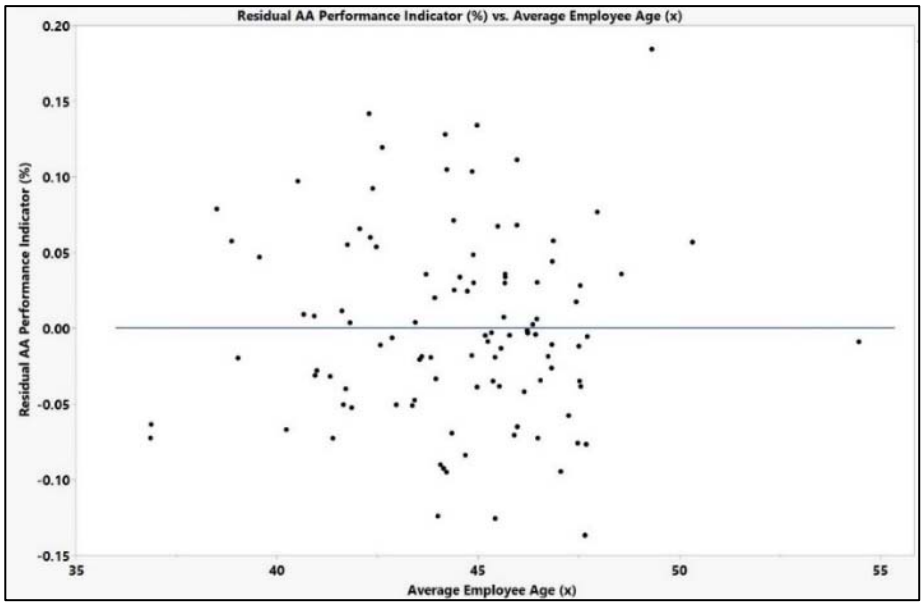

Figure 2. A Scatterplot for AA Residual (y) against Mean Employee Age (x)

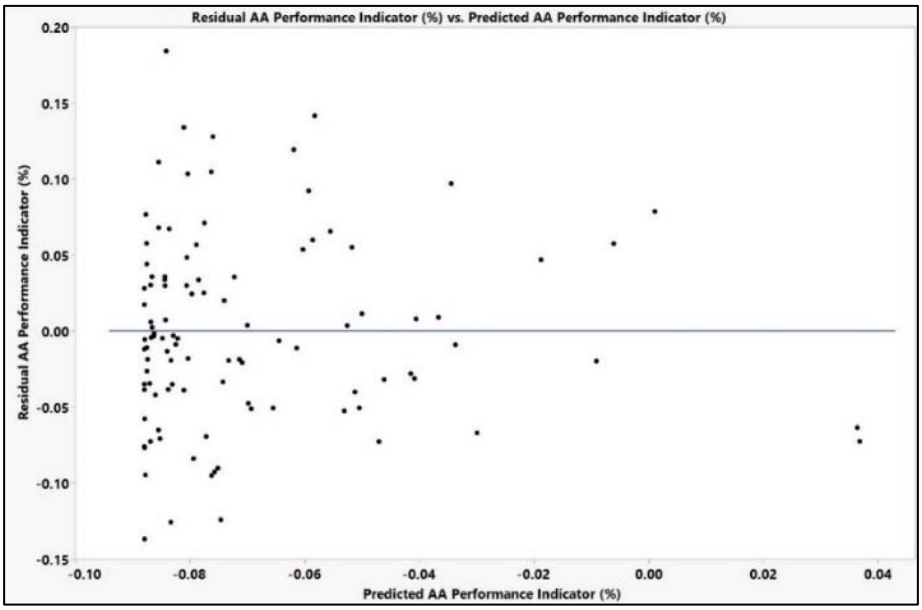

Figure 3. A Scatterplot for AA Residual (y) against AA Predicted (x)

The Correct Functional Form Assumption was checked using the plot of residuals against mean employee age (x) in Figure 2 and the plot of residuals against predicted ($\hat{y}$) in Figure 3. There are no obvious patterns in the residual plots that would suggest a more appropriate model such as dips, curves, alternations, etc. Therefore, this regression assumption does not appear to be violated.

The normality assumption was checked using the residual histogram in Figure 4. This histogram of appears to be reasonably bell-shaped and symmetric around 0. Therefore, this regression assumption does not appear to be violated.

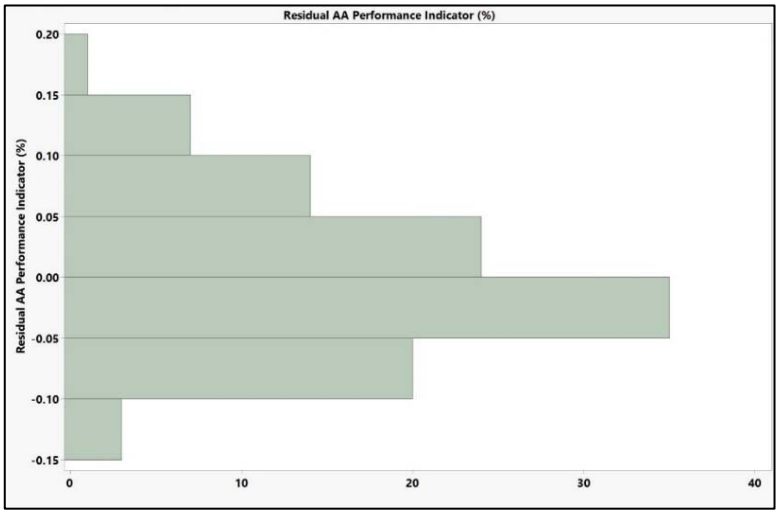

Figure 4. AA Residual Histogram

Graphical Analysis

In Figure 1, we can see that a lower Mean Employee Age results in a positive percent deviation from the local standard of Aircraft Availability. As Mean Employee Age increases, the parameters β_1 and β_2 create a downward curve with age increase, and then upward with further age increase. Within this data set, the minimum and maximum of the mean employee age ranges produces the highest AA Performance Indicator,

whereas the median of the mean employee age range produces a lower AA Performance Indicator.

Model 2: Flow Days (y) against Mean Employee Age (x)

Model 2 began with a scatterplot of Flow Days (y) against Mean Employee Age (x) to look for patterns. Fitting a linear line, this plot in Figure 5 does not appear graphically to have a strong positive or negative linear pattern--that is, it does not appear to be a strong example of a dependent variable increasing or decreasing linearly as the independent variable increases or decreases.

Superimposing a quadratic fit in Figure 1 over this same scatterplot shows that it also does not appear graphically to have a strong relationship. When two models were compared via regression, however, it was found that the quadratic relationship was a better fit. Therefore, it seems reasonable to attempt to relate y to x using a quadratic model (Bowerman et al., 2005:169).

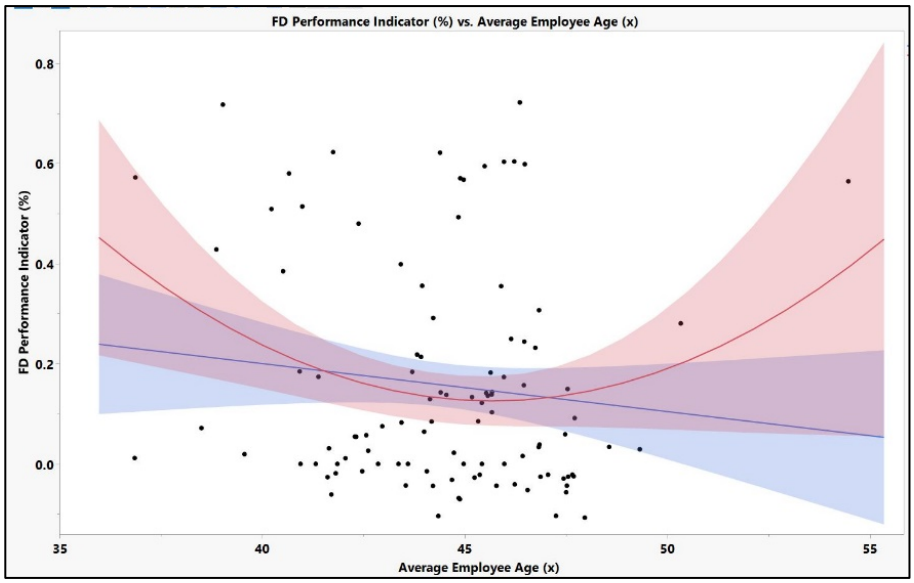

Figure 5. A Scatterplot for FD Performance Indicator (y) against Mean Employee Age (x)

After understanding these relationships, an additional column was added to the data set for the squared term (x^2), to reflect the rate of curvature for this parabola. The $\bar{R}^2$ for this model was 0.0410. The variability of the dependent variable or FD Performance Indicator in the model was explained by 4.10 percent. The resulting regression model is: $\hat{y} = 7.3463 - 0.3161x_1 + 0.0035x_1^2$. The overall model fit with F statistics is shown in Table 6.

Table 6. FD Performance Indicator Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.3060	0.1530	3.2290
Error	101	4.7920	0.0470	Prob > F
C. Total	103	5.0990		0.0437

As shown in Table 6, the overall fit for this model is significant at alpha = 0.05.

Mean Employee Age (x) Parameter β_1 Analysis

The significance level for the parameter (β_1) of Mean Employee Age (x) is 0.0247, which indicates strong evidence that x is significantly related to y, as shown in Table 5.

Table 7. FD Performance Indicator Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	7.3463	3.0734	2.3900	0.0187	1.2495	13.4431
Mean Employee Age (x)	-0.3161	0.1387	-2.2800	0.0247	-0.5911	-0.0411
Mean Employee Age Squared (x^2)	0.0035	0.0016	2.2100	0.0291	0.0004	0.0066

The significance level represents a 2.47 percent chance that this conclusion is incorrect (Type-I error), which means that it is extremely likely that the mean value of the dependent variable (y) changes as the independent variable (x) changes.

The parameter estimate for β_1 of the independent variable x in Table 5 is -0.3161. This means that for every unit-level increase of x (Mean Employee Age), the mean value of y will decrease by 0.3161. The parameter estimate for β_2 of the squared independent variable x^2 is 0.0035. This means that for every unit-level increase of x^2 (Mean Employee Age squared), the mean value of y will increase by 0.0035. Since this is a quadratic model, it is important to recognize that the β_1 and β_2 parameters need to be considered together when examining the model.

The 95 percent confidence intervals for the parameter estimate for β_1 of the independent variable x in Table 7 is [-0.5911, -0.0411]. This can be understood to mean that we are 95 percent confident that for any unit-level change in x, the mean value of y will increment/decrement (as appropriate) by a value within this range.

Mean Employee Age Squared (x^2) parameter β_2 Analysis

The significance level for the Mean Employee Age Squared (x^2) parameter (β_2) in Table 7 is 0.0291, which indicates strong evidence that x^2 is significantly related to y. The significance level represents a 2.91 percent chance that this conclusion is incorrect (Type-I error), which means that it is extremely likely that the mean value of the dependent variable (y) changes as the independent variable (x^2) changes.

The parameter estimate for β_1 of the independent variable x in Table 5 is -0.3161. This means that for every unit-level increase of x (Mean Employee Age), the mean value

of y will decrease by 0.3161. The parameter estimate for β_2 of the squared independent variable x^2 is 0.0035. This means that for every unit-level increase of x^2 (Mean Employee Age squared), the mean value of y will increase by 0.0035. Since this is a quadratic model, it is important to recognize that the β_1 and β_2 parameters need to be considered together when examining the model.

The 95 percent confidence intervals for the parameter estimate for β_2 of the independent variable x is [0.0004, 0.0066]. This can be understood to mean that we are 95 percent confident that for any unit-level change in x^2, the mean value of y will increment/decrement (as appropriate) by a number within this range.

Residual Analysis

The constant variance assumption was examined using the plot of residuals against mean employee age (x) in Figure 6 and the plot of residuals against predicted ($\hat{y}$) in Figure 7. The spread of residuals around 0 does not change much as the horizontal plot increases, but it does appear to be more heavily concentrated to the left side in the plot of residuals against predicted ($\hat{y}$). This model does appear to be slightly unbalanced. If violated, however, it would be suggested that caution be exercised when using this model to make statistical inferences.

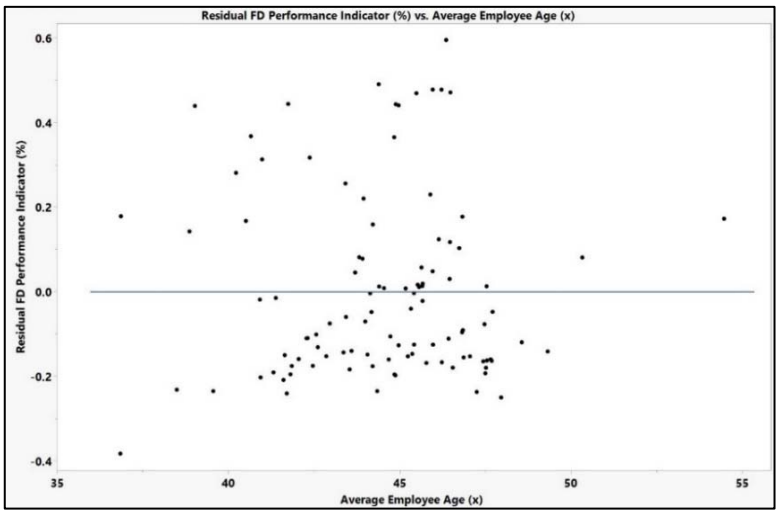

Figure 6. A Scatterplot for FD Residual (y) against Mean Employee Age (x)

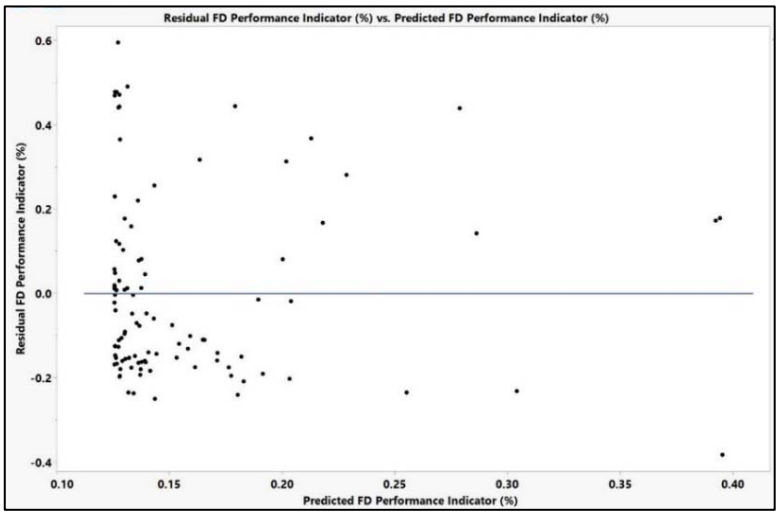

Figure 7. A Scatterplot for FD Residual (y) against FD Predicted (x)

The Correct Functional Form Assumption was checked using the plot of residuals against mean employee age (x) in Figure 6 and the plot of residuals against predicted ($\hat{y}$) in Figure 7. There are no obvious patterns in the residual plots that would suggest a more appropriate model such as dips, curves, alternations, etc. Therefore, this regression assumption does not appear to be violated.

The normality assumption was checked using the residual histogram in Figure 8. This histogram of appears to be reasonably bell-shaped and symmetric around 0. Therefore, this regression assumption does not appear to be violated.

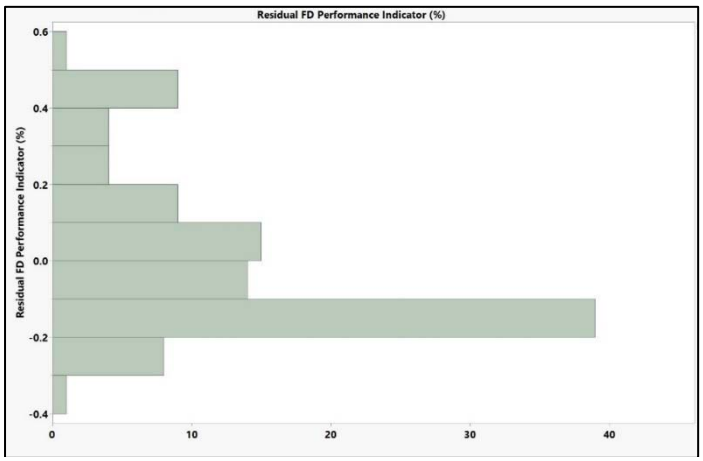

Figure 8. FD Residual Histogram

Graphical Analysis

In Figure 5, we can see that a lower Mean Employee Age results in a positive percent deviation from the local standard of scheduled flow days. As Mean Employee Age increases, the parameters β_1 and β_2 create a downward curve with age increase, and then upward with further age increase. Within this data set, the minimum and maximum of the mean employee age ranges produces the highest FD Performance Indicator, whereas the median of the mean employee age range produces a lower FD Performance Indicator.

Model 3: Production Hours (y) against Mean Employee Age (x)

Model 3 began with a scatterplot of Production Hours (y) against Mean Employee Age (x) to look for patterns. Fitting a linear line, this plot in Figure 9 does not appear

graphically to have a strong positive or negative linear pattern--that is, it does not appear to be a strong example of a dependent variable increasing or decreasing linearly as the independent variable increases or decreases.

Superimposing a quadratic fit in Figure 9 over this same scatterplot shows that it also does not appear graphically to have a strong relationship. When these two models were compared via regression, however, it was found that the linear relationship was a better fit. Therefore, it seems reasonable to attempt to relate y to x using simple linear model (Bowerman et al., 2005:79).

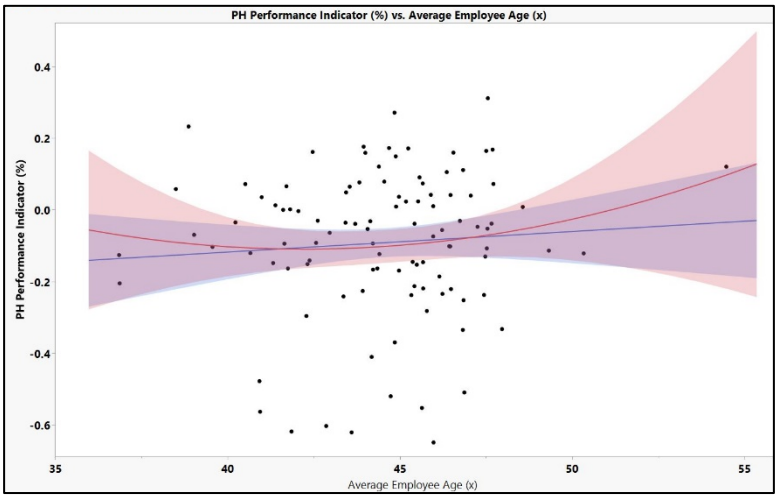

Figure 9. A Scatterplot for PH Performance Indicator (y) against Mean Employee Age (x)

After understanding these relationships, the linear model was created. The $\bar{R}^2$ for this model was 0, which means this model is a poor fit. The resulting regression model is: $\hat{y} = -0.3477 - 0.0057x_1$. The overall model fit with F statistics is shown in Table 8.

Table 8. PH Performance Indicator Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.0264	0.0265	0.6255
Error	101	4.3131	0.0423	Prob > F
C. Total	103	4.3396		0.4308

As shown in Table 8, the overall fit for this model is not significant.

Table 9. PH Performance Indicator Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.3477	0.3239	-1.0700	0.2856	-0.9901	0.2948
Mean Employee Age (x)	0.0057	0.0073	0.7900	0.4308	-0.0087	0.0201

Because this model is not statistically significant, the results of this study will not be interpreted.

V. Conclusions and Recommendations

Chapter Overview

Chapter 5 presents an overview of the linear regression results related to Aircraft Availability (y) against Mean Employee Age (x), Flow Days (y) against Mean Employee Age (x), and Production Hours (y) against Mean Employee Age (x). Additionally, it will offer recommendation about how to interpret and utilize this information as well as recommendations for future research.

Conclusions and Recommendations

The major contribution of this study is to answer the questions raised by the sponsor AFMC/A4:

IQ1: Is there a statistically significant relationship between Mean Employee Age and Aircraft Availability within the 561 AMXS.

In the case of Aircraft Availability (y) against Mean Employee Age (x), we have shown that there is a statistically significant relationship between the dependent variable (y) and the independent variable (x). In this data set, we observed a parabolic curve where the AA Performance Indicator is higher when near the minimum mean employee age, decreases as it reached the median mean employee age, then increases as it approaches the maximum mean employee age. This model shows that there is a significant relationship between these variables, however the model only accounts for approximately 11.95 percent of the variability between the actual and predicted values of the AA Performance Indicator. It is not recommended that this model be used to make statistical

inferences or extrapolate future scenarios without attempting to account for a larger amount of this variability.

IQ2: Is there a statistically significant relationship between Mean Employee Age and Product Flow Days within the 561 AMXS.

In the case of Flow Days (y) against Mean Employee Age (x), we have shown that there is a statistically significant relationship between the dependent variable (y) and the independent variable (x). In this data set, we observed a parabolic curve where the FD Performance Indicator is higher when near the minimum mean employee age, decreases as it reached the median mean employee age, then increases as it approaches the maximum mean employee age. This model shows that there is a significant relationship between these variables, however the model only accounts for approximately 4.1 percent of the variability between the actual and predicted values of the FD Performance Indicator. It is not recommended that this model be used to make statistical inferences or extrapolate future scenarios without attempting to account for a larger amount of this variability.

IQ3: Is there a statistically significant relationship between Mean Employee Age and Production Hours within the 561 AMXS.

In the case of Production Hours (y) against Mean Employee Age (x), we have not shown that there is not a statistically significant relationship between the dependent variable (y) and the independent variable (x). This model produced results which are inconclusive at this time and it is not recommended that this model be used to make statistical inferences or extrapolate future scenarios.

Limitations

These models show that although some of these variables have statistically significant relationships to each other, they should not be the only variables used to determine potential values of performance metrics. There is a large amount of variability that is unaccounted for, and it would be wise to examine other variables for inclusion in these models.

Future Research

In order to improve the limitations of this study, future research should examine additional potential variables such as employee longevity, employee education level, aircraft models, aircraft modifications, aircraft age, and other pertinent variables over time. Examining additional variables would ideally produce a model which shows statistically significant relationships and account for a larger amount of variability.

Appendix A: Consolidated Source Data

Period	Month	CY	FY	Mean Age	AA Performance Indicator	PH Performance Indicator	FD Performance Indicator
1	Oct	2012	2013	41.82	-4.90%	0.14%	-1.87%
2	Nov	2012	2013	41.61	-3.87%	0.00%	-2.64%
3	Dec	2012	2013	39.56	2.81%	-10.34%	1.94%
4	Jan	2013	2013	42.06	1.00%	-0.35%	1.14%
5	Feb	2013	2013	42.47	-0.67%	16.17%	-1.46%
6	Mar	2013	2013	42.62	5.74%	-3.02%	2.63%
7	Apr	2013	2013	49.32	10.01%	-11.38%	2.93%
8	May	2013	2013	42.29	8.33%	-29.65%	5.45%
9	Jun	2013	2013	38.50	7.97%	5.81%	7.17%
10	Jul	2013	2013	44.18	5.19%	-41.08%	8.46%
11	Aug	2013	2013	40.93	-3.27%	-47.87%	18.47%
12	Sep	2013	2013	44.22	2.84%	-16.69%	29.14%
13	Oct	2013	2014	40.52	6.26%	7.20%	38.48%
14	Nov	2013	2014	38.87	5.13%	23.29%	42.82%
15	Dec	2013	2014	42.38	3.29%	-14.13%	47.99%
16	Jan	2014	2014	45.49	-1.64%	-15.32%	59.45%
17	Feb	2014	2014	36.87	-2.73%	-20.53%	57.21%
18	Mar	2014	2014	41.75	0.33%	-16.36%	62.26%
19	Apr	2014	2014	45.97	2.57%	1.02%	60.33%
20	May	2014	2014	39.03	-2.89%	-6.98%	71.74%
21	Jun	2014	2014	44.97	5.29%	3.65%	56.75%
22	Jul	2014	2014	40.66	-2.77%	-12.08%	58.00%
23	Aug	2014	2014	44.39	-0.64%	12.08%	62.15%
24	Sep	2014	2014	44.89	-5.07%	0.91%	57.04%
25	Oct	2014	2015	40.23	-9.70%	-3.52%	50.90%
26	Nov	2014	2015	40.99	-6.96%	3.53%	51.41%
27	Dec	2014	2015	54.47	-4.28%	12.05%	56.43%
28	Jan	2015	2015	46.22	-8.78%	-5.63%	60.38%
29	Feb	2015	2015	46.36	-8.42%	10.55%	72.19%
30	Mar	2015	2015	44.84	-9.84%	27.16%	49.27%
31	Apr	2015	2015	43.95	-10.78%	17.64%	35.57%
32	May	2015	2015	45.57	-9.73%	9.07%	13.61%
33	Jun	2015	2015	45.24	-9.13%	17.17%	-2.72%
34	Jul	2015	2015	43.55	-9.17%	6.48%	-4.30%
35	Aug	2015	2015	44.88	-3.22%	14.95%	-7.05%
36	Sep	2015	2015	41.71	-9.14%	6.60%	-6.10%

37	Oct	2015	2016	46.55	-12.15%	15.98%	-5.22%
38	Nov	2015	2016	44.68	-16.34%	17.28%	-3.18%
39	Dec	2015	2016	47.55	-12.65%	31.17%	-2.57%
40	Jan	2016	2016	47.71	-9.35%	7.24%	9.15%
41	Feb	2016	2016	41.65	-10.11%	-9.44%	3.12%
42	Mar	2016	2016	42.96	-11.62%	-6.41%	7.53%
43	Apr	2016	2016	44.41	-5.25%	-12.35%	14.28%
44	May	2016	2016	45.42	-10.26%	-21.31%	12.19%
45	Jun	2016	2016	46.15	-12.81%	-18.61%	24.97%
46	Jul	2016	2016	45.18	-8.70%	2.32%	13.35%
47	Aug	2016	2016	45.67	-4.87%	-14.62%	10.31%
48	Sep	2016	2016	47.44	-7.06%	-23.78%	-2.92%
49	Oct	2016	2017	42.57	-7.26%	-9.22%	5.73%
50	Nov	2016	2017	36.86	-3.59%	-12.63%	1.18%
51	Dec	2016	2017	42.32	0.12%	-15.15%	5.42%
52	Jan	2017	2017	50.33	-2.21%	-12.16%	28.06%
53	Feb	2017	2017	45.97	-1.75%	-7.43%	17.35%
54	Mar	2017	2017	43.70	-3.68%	-3.92%	18.39%
55	Apr	2017	2017	45.66	-5.46%	7.38%	13.85%
56	May	2017	2017	43.42	-11.75%	-3.59%	39.87%
57	Jun	2017	2017	46.74	-10.60%	-3.10%	23.20%
58	Jul	2017	2017	46.83	-9.84%	11.13%	30.69%
59	Aug	2017	2017	45.90	-15.60%	4.19%	35.50%
60	Sep	2017	2017	46.47	-5.67%	4.13%	24.43%
61	Oct	2017	2018	43.82	-9.27%	7.67%	21.84%
62	Nov	2017	2018	45.53	-12.23%	2.36%	14.16%
63	Dec	2017	2018	48.56	-5.09%	0.81%	3.40%
64	Jan	2018	2018	47.54	-5.98%	-5.25%	14.97%
65	Feb	2018	2018	44.55	-4.49%	7.88%	13.79%
66	Mar	2018	2018	41.39	-11.98%	1.27%	17.40%
67	Apr	2018	2018	43.44	-6.62%	4.87%	8.27%
68	May	2018	2018	45.68	-5.06%	-21.96%	14.40%
69	Jun	2018	2018	46.46	-8.08%	-10.21%	15.71%
70	Jul	2018	2018	45.37	-11.82%	-14.52%	-2.17%
71	Aug	2018	2018	46.23	-8.96%	-23.47%	-4.08%
72	Sep	2018	2018	44.97	-12.01%	-16.98%	0.00%
73	Oct	2018	2019	41.32	-7.80%	-14.86%	0.00%
74	Nov	2018	2019	43.92	-5.40%	-22.67%	21.37%
75	Dec	2018	2019	45.33	-8.60%	-23.83%	8.51%
76	Jan	2019	2019	46.83	-11.39%	-33.55%	3.36%

77	Feb	2019	2019	45.98	-15.07%	-64.99%	0.00%
78	Mar	2019	2019	40.95	-7.21%	-56.41%	0.00%
79	Apr	2019	2019	41.86	-10.56%	-61.93%	0.00%
80	May	2019	2019	42.86	-7.09%	-60.39%	0.00%
81	Jun	2019	2019	46.87	-2.99%	-51.02%	-2.56%
82	Jul	2019	2019	43.60	-9.01%	-62.17%	0.00%
83	Aug	2019	2019	45.64	-7.70%	-55.35%	18.23%
84	Sep	2019	2019	44.73	-5.53%	-52.08%	2.22%
85	Oct	2019	2020	46.43	-9.10%	-10.17%	1.58%
86	Nov	2019	2020	46.48	-15.96%	-22.12%	59.85%
87	Dec	2019	2020	47.48	-16.39%	-13.04%	5.91%
88	Jan	2020	2020	47.50	-9.99%	16.46%	-5.66%
89	Feb	2020	2020	44.14	-16.84%	-3.19%	12.94%
90	Mar	2020	2020	46.85	-4.35%	-25.25%	3.86%
91	Apr	2020	2020	44.85	2.30%	-37.03%	-6.83%
92	May	2020	2020	47.96	-1.10%	-33.31%	-10.73%
93	Jun	2020	2020	47.52	-12.30%	-10.77%	-4.34%
94	Jul	2020	2020	45.78	-8.96%	-28.25%	-4.36%
95	Aug	2020	2020	47.25	-14.57%	-4.74%	-10.37%
96	Sep	2020	2020	44.35	-14.66%	-16.37%	-10.40%
97	Oct	2020	2021	44.06	-16.54%	-5.37%	0.00%
98	Nov	2020	2021	44.22	-17.14%	-9.40%	-0.26%
99	Dec	2020	2021	43.36	-12.05%	-24.20%	-3.25%
100	Jan	2021	2021	47.69	-16.47%	16.83%	-4.39%
101	Feb	2021	2021	47.66	-22.48%	-3.85%	0.00%
102	Mar	2021	2021	47.05	-18.25%	3.97%	-2.46%
103	Apr	2021	2021	45.42	-20.91%	-3.88%	-2.15%
104	May	2021	2021	44.00	-19.88%	15.92%	-2.15%
105	Jun	2021	2021	47.37	-26.98%	-5.34%	0.00%
106	Jul	2021	2021	42.76	-20.40%	-12.46%	6.43%
107	Aug	2021	2021	45.74	-20.76%	-11.64%	-5.77%

Appendix B: Personnel Variable Data

Period	Month	CY	FY	Mean Age
1	Oct	2012	2013	41.817
2	Nov	2012	2013	41.615
3	Dec	2012	2013	39.565
4	Jan	2013	2013	42.057
5	Feb	2013	2013	42.470
6	Mar	2013	2013	42.617
7	Apr	2013	2013	49.321
8	May	2013	2013	42.288
9	Jun	2013	2013	38.503
10	Jul	2013	2013	44.181
11	Aug	2013	2013	40.927
12	Sep	2013	2013	44.222
13	Oct	2013	2014	40.517
14	Nov	2013	2014	38.872
15	Dec	2013	2014	42.380
16	Jan	2014	2014	45.491
17	Feb	2014	2014	36.873
18	Mar	2014	2014	41.752
19	Apr	2014	2014	45.968
20	May	2014	2014	39.032
21	Jun	2014	2014	44.973
22	Jul	2014	2014	40.663
23	Aug	2014	2014	44.391
24	Sep	2014	2014	44.890
25	Oct	2014	2015	40.230
26	Nov	2014	2015	40.992
27	Dec	2014	2015	54.467
28	Jan	2015	2015	46.223
29	Feb	2015	2015	46.360
30	Mar	2015	2015	44.844
31	Apr	2015	2015	43.949
32	May	2015	2015	45.570
33	Jun	2015	2015	45.242
34	Jul	2015	2015	43.545
35	Aug	2015	2015	44.879
36	Sep	2015	2015	41.710
37	Oct	2015	2016	46.552

38	Nov	2015	2016	44.684
39	Dec	2015	2016	47.551
40	Jan	2016	2016	47.713
41	Feb	2016	2016	41.651
42	Mar	2016	2016	42.965
43	Apr	2016	2016	44.405
44	May	2016	2016	45.421
45	Jun	2016	2016	46.145
46	Jul	2016	2016	45.178
47	Aug	2016	2016	45.671
48	Sep	2016	2016	47.440
49	Oct	2016	2017	42.570
50	Nov	2016	2017	36.855
51	Dec	2016	2017	42.320
52	Jan	2017	2017	50.331
53	Feb	2017	2017	45.966
54	Mar	2017	2017	43.704
55	Apr	2017	2017	45.664
56	May	2017	2017	43.422
57	Jun	2017	2017	46.741
58	Jul	2017	2017	46.833
59	Aug	2017	2017	45.898
60	Sep	2017	2017	46.469
61	Oct	2017	2018	43.825
62	Nov	2017	2018	45.530
63	Dec	2017	2018	48.564
64	Jan	2018	2018	47.539
65	Feb	2018	2018	44.547
66	Mar	2018	2018	41.390
67	Apr	2018	2018	43.439
68	May	2018	2018	45.675
69	Jun	2018	2018	46.459
70	Jul	2018	2018	45.371
71	Aug	2018	2018	46.234
72	Sep	2018	2018	44.973
73	Oct	2018	2019	41.323
74	Nov	2018	2019	43.922
75	Dec	2018	2019	45.332
76	Jan	2019	2019	46.825
77	Feb	2019	2019	45.976

78	Mar	2019	2019	40.947
79	Apr	2019	2019	41.857
80	May	2019	2019	42.862
81	Jun	2019	2019	46.869
82	Jul	2019	2019	43.600
83	Aug	2019	2019	45.639
84	Sep	2019	2019	44.733
85	Oct	2019	2020	46.429
86	Nov	2019	2020	46.483
87	Dec	2019	2020	47.477
88	Jan	2020	2020	47.504
89	Feb	2020	2020	44.141
90	Mar	2020	2020	46.846
91	Apr	2020	2020	44.852
92	May	2020	2020	47.962
93	Jun	2020	2020	47.521
94	Jul	2020	2020	45.782
95	Aug	2020	2020	47.251
96	Sep	2020	2020	44.348
97	Oct	2020	2021	44.064
98	Nov	2020	2021	44.215
99	Dec	2020	2021	43.364
100	Jan	2021	2021	47.688
101	Feb	2021	2021	47.657
102	Mar	2021	2021	47.055
103	Apr	2021	2021	45.424
104	May	2021	2021	43.998
105	Jun	2021	2021	47.368
106	Jul	2021	2021	42.763
107	Aug	2021	2021	45.743

Appendix C: Aircraft Availability Variable Data

Period	Month	CY	MDS	Available (%)	Available Std (%)	AA Performance Indicator (%)
1	Oct	2012	F015C	60.01%	61.00%	-1.62%
2	Nov	2012	F015C	58.94%	61.00%	-3.38%
3	Dec	2012	F015C	61.83%	61.00%	1.36%
4	Jan	2013	F015C	60.36%	61.00%	-1.05%
5	Feb	2013	F015C	62.30%	61.00%	2.13%
6	Mar	2013	F015C	63.68%	61.00%	4.39%
7	Apr	2013	F015C	65.85%	61.00%	7.95%
8	May	2013	F015C	66.60%	61.00%	9.18%
9	Jun	2013	F015C	63.36%	61.00%	3.87%
10	Jul	2013	F015C	64.34%	61.00%	5.48%
11	Aug	2013	F015C	61.54%	61.00%	0.89%
12	Sep	2013	F015C	64.28%	61.00%	5.38%
1	Oct	2012	F015D	51.49%	61.00%	-15.59%
2	Nov	2012	F015D	53.56%	61.00%	-12.20%
3	Dec	2012	F015D	61.36%	61.00%	0.59%
4	Jan	2013	F015D	57.68%	61.00%	-5.44%
5	Feb	2013	F015D	54.23%	61.00%	-11.10%
6	Mar	2013	F015D	61.47%	61.00%	0.77%
7	Apr	2013	F015D	66.70%	61.00%	9.34%
8	May	2013	F015D	64.26%	61.00%	5.34%
9	Jun	2013	F015D	68.06%	61.00%	11.57%
10	Jul	2013	F015D	62.45%	61.00%	2.38%
11	Aug	2013	F015D	58.80%	61.00%	-3.61%
12	Sep	2013	F015D	62.63%	61.00%	2.67%
1	Oct	2012	F015E	68.37%	66.70%	2.50%
2	Nov	2012	F015E	69.35%	66.70%	3.97%
3	Dec	2012	F015E	71.02%	66.70%	6.48%
4	Jan	2013	F015E	73.04%	66.70%	9.51%
5	Feb	2013	F015E	71.35%	66.70%	6.97%
6	Mar	2013	F015E	74.75%	66.70%	12.07%
7	Apr	2013	F015E	75.19%	66.70%	12.73%
8	May	2013	F015E	73.69%	66.70%	10.48%
9	Jun	2013	F015E	72.35%	66.70%	8.47%
10	Jul	2013	F015E	71.85%	66.70%	7.72%

11	Aug	2013	F015E	61.98%	66.70%	-7.08%
12	Sep	2013	F015E	67.02%	66.70%	0.48%
13	Oct	2013	F015C	64.12%	61.00%	5.11%
14	Nov	2013	F015C	61.79%	61.00%	1.30%
15	Dec	2013	F015C	61.04%	61.00%	0.07%
16	Jan	2014	F015C	60.56%	61.00%	-0.72%
17	Feb	2014	F015C	61.80%	61.00%	1.31%
18	Mar	2014	F015C	62.23%	61.00%	2.02%
19	Apr	2014	F015C	58.19%	61.00%	-4.61%
20	May	2014	F015C	60.34%	61.00%	-1.08%
21	Jun	2014	F015C	66.00%	61.00%	8.20%
22	Jul	2014	F015C	64.78%	61.00%	6.20%
23	Aug	2014	F015C	62.25%	61.00%	2.05%
24	Sep	2014	F015C	58.15%	61.00%	-4.67%
13	Oct	2013	F015D	66.08%	61.00%	8.33%
14	Nov	2013	F015D	69.50%	61.00%	13.93%
15	Dec	2013	F015D	69.08%	61.00%	13.25%
16	Jan	2014	F015D	60.45%	61.00%	-0.90%
17	Feb	2014	F015D	58.62%	61.00%	-3.90%
18	Mar	2014	F015D	60.21%	61.00%	-1.30%
19	Apr	2014	F015D	69.28%	61.00%	13.57%
20	May	2014	F015D	57.95%	61.00%	-5.00%
21	Jun	2014	F015D	67.57%	61.00%	10.77%
22	Jul	2014	F015D	57.59%	61.00%	-5.59%
23	Aug	2014	F015D	64.18%	61.00%	5.21%
24	Sep	2014	F015D	56.66%	61.00%	-7.11%
13	Oct	2013	F015E	70.26%	66.70%	5.34%
14	Nov	2013	F015E	66.81%	66.70%	0.16%
15	Dec	2013	F015E	64.41%	66.70%	-3.43%
16	Jan	2014	F015E	64.50%	66.70%	-3.30%
17	Feb	2014	F015E	62.96%	66.70%	-5.61%
18	Mar	2014	F015E	66.88%	66.70%	0.27%
19	Apr	2014	F015E	65.86%	66.70%	-1.26%
20	May	2014	F015E	64.97%	66.70%	-2.59%
21	Jun	2014	F015E	64.63%	66.70%	-3.10%
22	Jul	2014	F015E	60.76%	66.70%	-8.91%
23	Aug	2014	F015E	60.58%	66.70%	-9.18%
24	Sep	2014	F015E	64.41%	66.70%	-3.43%
25	Oct	2014	F015C	57.51%	63.70%	-9.72%
26	Nov	2014	F015C	60.24%	63.70%	-5.43%

27	Dec	2014	F015C	63.43%	63.70%	-0.42%
28	Jan	2015	F015C	59.55%	63.70%	-6.51%
29	Feb	2015	F015C	59.86%	63.70%	-6.03%
30	Mar	2015	F015C	60.66%	63.70%	-4.77%
31	Apr	2015	F015C	61.69%	63.70%	-3.16%
32	May	2015	F015C	56.86%	63.70%	-10.74%
33	Jun	2015	F015C	57.70%	63.70%	-9.42%
34	Jul	2015	F015C	55.36%	63.70%	-13.09%
35	Aug	2015	F015C	58.10%	63.70%	-8.79%
36	Sep	2015	F015C	59.68%	63.70%	-6.31%
25	Oct	2014	F015D	54.11%	63.70%	-15.05%
26	Nov	2014	F015D	57.23%	63.70%	-10.16%
27	Dec	2014	F015D	55.37%	63.70%	-13.08%
28	Jan	2015	F015D	53.51%	63.70%	-16.00%
29	Feb	2015	F015D	57.17%	63.70%	-10.25%
30	Mar	2015	F015D	50.77%	63.70%	-20.30%
31	Apr	2015	F015D	48.98%	63.70%	-23.11%
32	May	2015	F015D	54.29%	63.70%	-14.77%
33	Jun	2015	F015D	58.20%	63.70%	-8.63%
34	Jul	2015	F015D	59.66%	63.70%	-6.34%
35	Aug	2015	F015D	67.44%	63.70%	5.87%
36	Sep	2015	F015D	52.77%	63.70%	-17.16%
25	Oct	2014	F015E	63.24%	66.10%	-4.33%
26	Nov	2014	F015E	62.61%	66.10%	-5.28%
27	Dec	2014	F015E	66.54%	66.10%	0.67%
28	Jan	2015	F015E	63.56%	66.10%	-3.84%
29	Feb	2015	F015E	60.16%	66.10%	-8.99%
30	Mar	2015	F015E	63.15%	66.10%	-4.46%
31	Apr	2015	F015E	62.09%	66.10%	-6.07%
32	May	2015	F015E	63.66%	66.10%	-3.69%
33	Jun	2015	F015E	59.92%	66.10%	-9.35%
34	Jul	2015	F015E	60.76%	66.10%	-8.08%
35	Aug	2015	F015E	61.65%	66.10%	-6.73%
36	Sep	2015	F015E	63.49%	66.10%	-3.95%
37	Oct	2015	F015C	59.11%	63.00%	-6.17%
38	Nov	2015	F015C	60.11%	63.00%	-4.59%
39	Dec	2015	F015C	63.19%	63.00%	0.30%
40	Jan	2016	F015C	60.21%	63.00%	-4.43%
41	Feb	2016	F015C	58.97%	63.00%	-6.40%
42	Mar	2016	F015C	59.22%	63.00%	-6.00%

43	Apr	2016	F015C	56.63%	63.00%	-10.11%
44	May	2016	F015C	58.71%	63.00%	-6.81%
45	Jun	2016	F015C	55.31%	63.00%	-12.21%
46	Jul	2016	F015C	54.60%	63.00%	-13.33%
47	Aug	2016	F015C	55.75%	63.00%	-11.51%
48	Sep	2016	F015C	57.15%	63.00%	-9.29%
37	Oct	2015	F015D	43.88%	63.00%	-30.35%
38	Nov	2015	F015D	38.71%	63.00%	-38.56%
39	Dec	2015	F015D	46.53%	63.00%	-26.14%
40	Jan	2016	F015D	53.55%	63.00%	-15.00%
41	Feb	2016	F015D	50.26%	63.00%	-20.22%
42	Mar	2016	F015D	51.84%	63.00%	-17.71%
43	Apr	2016	F015D	60.53%	63.00%	-3.92%
44	May	2016	F015D	48.87%	63.00%	-22.43%
45	Jun	2016	F015D	50.13%	63.00%	-20.43%
46	Jul	2016	F015D	56.58%	63.00%	-10.19%
47	Aug	2016	F015D	63.32%	63.00%	0.51%
48	Sep	2016	F015D	54.89%	63.00%	-12.87%
37	Oct	2015	F015E	66.04%	66.00%	0.06%
38	Nov	2015	F015E	62.13%	66.00%	-5.86%
39	Dec	2015	F015E	58.00%	66.00%	-12.12%
40	Jan	2016	F015E	60.31%	66.00%	-8.62%
41	Feb	2016	F015E	63.55%	66.00%	-3.71%
42	Mar	2016	F015E	58.64%	66.00%	-11.15%
43	Apr	2016	F015E	64.87%	66.00%	-1.71%
44	May	2016	F015E	64.98%	66.00%	-1.55%
45	Jun	2016	F015E	62.18%	66.00%	-5.79%
46	Jul	2016	F015E	64.29%	66.00%	-2.59%
47	Aug	2016	F015E	63.62%	66.00%	-3.61%
48	Sep	2016	F015E	66.64%	66.00%	0.97%
49	Oct	2016	F015C	55.91%	63.00%	-11.25%
50	Nov	2016	F015C	57.15%	63.00%	-9.29%
51	Dec	2016	F015C	56.33%	63.00%	-10.59%
52	Jan	2017	F015C	61.71%	63.00%	-2.05%
53	Feb	2017	F015C	60.44%	63.00%	-4.06%
54	Mar	2017	F015C	60.50%	63.00%	-3.97%
55	Apr	2017	F015C	60.47%	63.00%	-4.02%
56	May	2017	F015C	58.34%	63.00%	-7.40%
57	Jun	2017	F015C	56.99%	63.00%	-9.54%
58	Jul	2017	F015C	54.78%	63.00%	-13.05%

59	Aug	2017	F015C	55.96%	63.00%	-11.17%
60	Sep	2017	F015C	58.20%	63.00%	-7.62%
49	Oct	2016	F015D	53.29%	63.00%	-15.41%
50	Nov	2016	F015D	58.20%	63.00%	-7.62%
51	Dec	2016	F015D	67.72%	63.00%	7.49%
52	Jan	2017	F015D	61.80%	63.00%	-1.90%
53	Feb	2017	F015D	66.31%	63.00%	5.25%
54	Mar	2017	F015D	62.21%	63.00%	-1.25%
55	Apr	2017	F015D	58.59%	63.00%	-7.00%
56	May	2017	F015D	48.16%	63.00%	-23.56%
57	Jun	2017	F015D	53.77%	63.00%	-14.65%
58	Jul	2017	F015D	54.10%	63.00%	-14.13%
59	Aug	2017	F015D	45.40%	63.00%	-27.94%
60	Sep	2017	F015D	59.14%	63.00%	-6.13%
49	Oct	2016	F015E	69.22%	66.00%	4.88%
50	Nov	2016	F015E	70.05%	66.00%	6.14%
51	Dec	2016	F015E	68.29%	66.00%	3.47%
52	Jan	2017	F015E	64.23%	66.00%	-2.68%
53	Feb	2017	F015E	61.75%	66.00%	-6.44%
54	Mar	2017	F015E	62.17%	66.00%	-5.80%
55	Apr	2017	F015E	62.46%	66.00%	-5.36%
56	May	2017	F015E	63.17%	66.00%	-4.29%
57	Jun	2017	F015E	60.97%	66.00%	-7.62%
58	Jul	2017	F015E	64.45%	66.00%	-2.35%
59	Aug	2017	F015E	60.93%	66.00%	-7.68%
60	Sep	2017	F015E	63.85%	66.00%	-3.26%
61	Oct	2017	F015C	56.58%	63.00%	-10.19%
62	Nov	2017	F015C	60.22%	63.00%	-4.41%
63	Dec	2017	F015C	59.99%	63.00%	-4.78%
64	Jan	2018	F015C	62.26%	63.00%	-1.17%
65	Feb	2018	F015C	60.75%	63.00%	-3.57%
66	Mar	2018	F015C	61.18%	63.00%	-2.89%
67	Apr	2018	F015C	61.77%	63.00%	-1.95%
68	May	2018	F015C	64.59%	63.00%	2.52%
69	Jun	2018	F015C	63.33%	63.00%	0.52%
70	Jul	2018	F015C	62.19%	63.00%	-1.29%
71	Aug	2018	F015C	62.08%	63.00%	-1.46%
72	Sep	2018	F015C	64.99%	63.00%	3.16%
61	Oct	2017	F015D	54.56%	63.00%	-13.40%
62	Nov	2017	F015D	46.93%	63.00%	-25.51%

63	Dec	2017	F015D	62.01%	63.00%	-1.57%
64	Jan	2018	F015D	59.85%	63.00%	-5.00%
65	Feb	2018	F015D	65.54%	63.00%	4.03%
66	Mar	2018	F015D	54.55%	63.00%	-13.41%
67	Apr	2018	F015D	58.48%	63.00%	-7.17%
68	May	2018	F015D	60.07%	63.00%	-4.65%
69	Jun	2018	F015D	53.14%	63.00%	-15.65%
70	Jul	2018	F015D	50.10%	63.00%	-20.48%
71	Aug	2018	F015D	56.36%	63.00%	-10.54%
72	Sep	2018	F015D	46.48%	63.00%	-26.22%
61	Oct	2017	F015E	63.22%	66.00%	-4.21%
62	Nov	2017	F015E	61.54%	66.00%	-6.76%
63	Dec	2017	F015E	60.11%	66.00%	-8.92%
64	Jan	2018	F015E	58.23%	66.00%	-11.77%
65	Feb	2018	F015E	56.81%	66.00%	-13.92%
66	Mar	2018	F015E	53.03%	66.00%	-19.65%
67	Apr	2018	F015E	58.91%	66.00%	-10.74%
68	May	2018	F015E	57.38%	66.00%	-13.06%
69	Jun	2018	F015E	59.98%	66.00%	-9.12%
70	Jul	2018	F015E	56.96%	66.00%	-13.70%
71	Aug	2018	F015E	56.18%	66.00%	-14.88%
72	Sep	2018	F015E	57.45%	66.00%	-12.95%
73	Oct	2018	F015C	61.05%	57.00%	7.11%
74	Nov	2018	F015C	58.77%	57.00%	3.11%
75	Dec	2018	F015C	57.11%	57.00%	0.19%
76	Jan	2019	F015C	59.42%	57.00%	4.25%
77	Feb	2019	F015C	58.14%	57.00%	2.00%
78	Mar	2019	F015C	56.04%	57.00%	-1.68%
79	Apr	2019	F015C	54.14%	57.00%	-5.02%
80	May	2019	F015C	57.36%	57.00%	0.63%
81	Jun	2019	F015C	59.66%	57.00%	4.67%
82	Jul	2019	F015C	56.19%	57.00%	-1.42%
83	Aug	2019	F015C	56.78%	57.00%	-0.39%
84	Sep	2019	F015C	57.06%	57.00%	0.11%
73	Oct	2018	F015D	48.75%	57.00%	-14.47%
74	Nov	2018	F015D	51.94%	57.00%	-8.88%
75	Dec	2018	F015D	46.19%	57.00%	-18.96%
76	Jan	2019	F015D	41.44%	57.00%	-27.30%
77	Feb	2019	F015D	36.72%	57.00%	-35.58%
78	Mar	2019	F015D	48.06%	57.00%	-15.68%

79	Apr	2019	F015D	44.63%	57.00%	-21.70%
80	May	2019	F015D	49.04%	57.00%	-13.96%
81	Jun	2019	F015D	53.76%	57.00%	-5.68%
82	Jul	2019	F015D	47.84%	57.00%	-16.07%
83	Aug	2019	F015D	51.61%	57.00%	-9.46%
84	Sep	2019	F015D	53.08%	57.00%	-6.88%
73	Oct	2018	F015E	55.41%	66.00%	-16.05%
74	Nov	2018	F015E	59.12%	66.00%	-10.42%
75	Dec	2018	F015E	61.37%	66.00%	-7.02%
76	Jan	2019	F015E	58.66%	66.00%	-11.12%
77	Feb	2019	F015E	58.33%	66.00%	-11.62%
78	Mar	2019	F015E	63.18%	66.00%	-4.27%
79	Apr	2019	F015E	62.72%	66.00%	-4.97%
80	May	2019	F015E	60.76%	66.00%	-7.94%
81	Jun	2019	F015E	60.75%	66.00%	-7.95%
82	Jul	2019	F015E	59.70%	66.00%	-9.55%
83	Aug	2019	F015E	57.25%	66.00%	-13.26%
84	Sep	2019	F015E	59.52%	66.00%	-9.82%
85	Oct	2019	F015C	58.91%	57.00%	3.35%
86	Nov	2019	F015C	58.00%	57.00%	1.75%
87	Dec	2019	F015C	58.97%	57.00%	3.46%
88	Jan	2020	F015C	61.44%	57.00%	7.79%
89	Feb	2020	F015C	57.12%	57.00%	0.21%
90	Mar	2020	F015C	62.77%	57.00%	10.12%
91	Apr	2020	F015C	68.01%	57.00%	19.32%
92	May	2020	F015C	65.13%	57.00%	14.26%
93	Jun	2020	F015C	58.78%	57.00%	3.12%
94	Jul	2020	F015C	56.43%	57.00%	-1.00%
95	Aug	2020	F015C	55.74%	57.00%	-2.21%
96	Sep	2020	F015C	56.83%	57.00%	-0.30%
85	Oct	2019	F015D	44.28%	57.00%	-22.32%
86	Nov	2019	F015D	34.04%	57.00%	-40.28%
87	Dec	2019	F015D	30.86%	57.00%	-45.86%
88	Jan	2020	F015D	39.85%	57.00%	-30.09%
89	Feb	2020	F015D	33.88%	57.00%	-40.56%
90	Mar	2020	F015D	42.59%	57.00%	-25.28%
91	Apr	2020	F015D	47.97%	57.00%	-15.84%
92	May	2020	F015D	47.64%	57.00%	-16.42%
93	Jun	2020	F015D	40.11%	57.00%	-29.63%
94	Jul	2020	F015D	49.82%	57.00%	-12.60%

95	Aug	2020	F015D	43.44%	57.00%	-23.79%
96	Sep	2020	F015D	39.48%	57.00%	-30.74%
85	Oct	2019	F015E	60.50%	66.00%	-8.33%
86	Nov	2019	F015E	59.83%	66.00%	-9.35%
87	Dec	2019	F015E	61.53%	66.00%	-6.77%
88	Jan	2020	F015E	60.93%	66.00%	-7.68%
89	Feb	2020	F015E	59.29%	66.00%	-10.17%
90	Mar	2020	F015E	67.39%	66.00%	2.11%
91	Apr	2020	F015E	68.27%	66.00%	3.44%
92	May	2020	F015E	65.24%	66.00%	-1.15%
93	Jun	2020	F015E	59.14%	66.00%	-10.39%
94	Jul	2020	F015E	57.24%	66.00%	-13.27%
95	Aug	2020	F015E	54.31%	66.00%	-17.71%
96	Sep	2020	F015E	57.46%	66.00%	-12.94%
97	Oct	2020	F015C	58.22%	61.00%	-4.56%
98	Nov	2020	F015C	58.47%	61.00%	-4.15%
99	Dec	2020	F015C	57.32%	61.00%	-6.03%
100	Jan	2021	F015C	57.61%	61.00%	-5.56%
101	Feb	2021	F015C	55.45%	61.00%	-9.10%
102	Mar	2021	F015C	55.58%	61.00%	-8.89%
103	Apr	2021	F015C	57.09%	61.00%	-6.41%
104	May	2021	F015C	56.01%	61.00%	-8.18%
105	Jun	2021	F015C	52.20%	61.00%	-14.43%
106	Jul	2021	F015C	53.83%	61.00%	-11.75%
107	Aug	2021	F015C	54.02%	61.00%	-11.44%
97	Oct	2020	F015D	41.43%	61.00%	-32.08%
98	Nov	2020	F015D	41.34%	61.00%	-32.23%
99	Dec	2020	F015D	51.19%	61.00%	-16.08%
100	Jan	2021	F015D	40.02%	61.00%	-34.39%
101	Feb	2021	F015D	34.11%	61.00%	-44.08%
102	Mar	2021	F015D	40.75%	61.00%	-33.20%
103	Apr	2021	F015D	34.07%	61.00%	-44.15%
104	May	2021	F015D	38.97%	61.00%	-36.11%
105	Jun	2021	F015D	30.14%	61.00%	-50.59%
106	Jul	2021	F015D	38.29%	61.00%	-37.23%
107	Aug	2021	F015D	37.81%	61.00%	-38.02%
97	Oct	2020	F015E	55.70%	64.00%	-12.97%
98	Nov	2020	F015E	54.37%	64.00%	-15.05%
99	Dec	2020	F015E	55.02%	64.00%	-14.03%
100	Jan	2021	F015E	57.95%	64.00%	-9.45%

101	Feb	2021	F015E	54.88%	64.00%	-14.25%
102	Mar	2021	F015E	55.89%	64.00%	-12.67%
103	Apr	2021	F015E	56.20%	64.00%	-12.19%
104	May	2021	F015E	54.18%	64.00%	-15.34%
105	Jun	2021	F015E	53.81%	64.00%	-15.92%
106	Jul	2021	F015E	56.19%	64.00%	-12.20%
107	Aug	2021	F015E	55.79%	64.00%	-12.83%

Appendix D: Product Flow Days Variable Data

Period	Month	CY	Scheduled Flow Days	Actual Flow Days	PH Performance Indicator (%)
1	Oct	2012	190	188	-1.05%
1	Oct	2012	127	119	-6.30%
1	Oct	2012	170	170	0.00%
1	Oct	2012	127	127	0.00%
1	Oct	2012	186	186	0.00%
1	Oct	2012	125	124	-0.80%
1	Oct	2012	127	119	-6.30%
1	Oct	2012	185	184	-0.54%
2	Nov	2012	141	141	0.00%
2	Nov	2012	127	119	-6.30%
2	Nov	2012	125	122	-2.40%
2	Nov	2012	191	190	-0.52%
2	Nov	2012	126	121	-3.97%
3	Dec	2012	125	123	-1.60%
3	Dec	2012	126	122	-3.17%
3	Dec	2012	192	196	2.08%
3	Dec	2012	124	130	4.84%
3	Dec	2012	185	199	7.57%
4	Jan	2013	195	195	0.00%
4	Jan	2013	195	194	-0.51%
4	Jan	2013	135	134	-0.74%
4	Jan	2013	138	146	5.80%
5	Feb	2013	175	162	-7.43%
5	Feb	2013	135	131	-2.96%
5	Feb	2013	137	137	0.00%
5	Feb	2013	194	200	3.09%
5	Feb	2013	135	135	0.00%
6	Mar	2013	144	144	0.00%
6	Mar	2013	203	203	0.00%
6	Mar	2013	195	194	-0.51%
6	Mar	2013	135	141	4.44%
6	Mar	2013	135	144	6.67%
6	Mar	2013	135	142	5.19%
7	Apr	2013	145	147	1.38%
7	Apr	2013	135	146	8.15%

7	Apr	2013	135	134	-0.74%
8	May	2013	226	234	3.54%
8	May	2013	195	204	4.62%
8	May	2013	135	159	17.78%
8	May	2013	137	141	2.92%
8	May	2013	195	195	0.00%
8	May	2013	155	161	3.87%
9	Jun	2013	127	127	0.00%
9	Jun	2013	155	151	-2.58%
9	Jun	2013	127	169	33.07%
9	Jun	2013	125	125	0.00%
9	Jun	2013	194	194	0.00%
9	Jun	2013	128	144	12.50%
10	Jul	2013	154	176	14.29%
10	Jul	2013	125	131	4.80%
10	Jul	2013	125	134	7.20%
10	Jul	2013	185	199	7.57%
11	Aug	2013	160	193	20.63%
11	Aug	2013	230	268	16.52%
11	Aug	2013	126	149	18.25%
12	Sep	2013	126	158	25.40%
12	Sep	2013	187	217	16.04%
12	Sep	2013	127	180	41.73%
12	Sep	2013	125	166	32.80%
12	Sep	2013	185	240	29.73%
13	Oct	2013	185	221	19.46%
13	Oct	2013	150	235	56.67%
13	Oct	2013	139	181	30.22%
13	Oct	2013	124	183	47.58%
14	Nov	2013	185	234	26.49%
14	Nov	2013	126	192	52.38%
14	Nov	2013	125	187	49.60%
15	Dec	2013	126	195	54.76%
15	Dec	2013	126	188	49.21%
15	Dec	2013	160	224	40.00%
16	Jan	2014	125	214	71.20%
16	Jan	2014	126	203	61.11%
16	Jan	2014	129	202	56.59%
16	Jan	2014	188	295	56.91%
16	Jan	2014	184	285	54.89%

16	Jan	2014	125	195	56.00%
17	Feb	2014	125	211	68.80%
17	Feb	2014	186	292	56.99%
17	Feb	2014	125	203	62.40%
17	Feb	2014	185	266	43.78%
17	Feb	2014	185	285	54.05%
18	Mar	2014	125	213	70.40%
18	Mar	2014	159	253	59.12%
18	Mar	2014	197	273	38.58%
18	Mar	2014	126	228	80.95%
19	Apr	2014	126	243	92.86%
19	Apr	2014	195	282	44.62%
19	Apr	2014	194	269	38.66%
19	Apr	2014	135	223	65.19%
20	May	2014	135	248	83.70%
20	May	2014	155	228	47.10%
20	May	2014	135	259	91.85%
20	May	2014	166	239	43.98%
20	May	2014	139	267	92.09%
21	Jun	2014	135	167	23.70%
21	Jun	2014	135	256	89.63%
21	Jun	2014	196	295	50.51%
21	Jun	2014	169	263	55.62%
21	Jun	2014	136	227	66.91%
21	Jun	2014	196	285	45.41%
21	Jun	2014	139	230	65.47%
22	Jul	2014	138	227	64.49%
22	Jul	2014	197	290	47.21%
22	Jul	2014	138	225	63.04%
22	Jul	2014	135	233	72.59%
22	Jul	2014	197	281	42.64%
23	Aug	2014	126	216	71.43%
23	Aug	2014	196	272	38.78%
23	Aug	2014	126	219	73.81%
23	Aug	2014	127	209	64.57%
24	Sep	2014	125	206	64.80%
24	Sep	2014	126	216	71.43%
24	Sep	2014	126	202	60.32%
24	Sep	2014	207	249	20.29%
24	Sep	2014	122	193	58.20%

24	Sep	2014	125	209	67.20%
25	Oct	2014	126	188	49.21%
25	Oct	2014	126	188	49.21%
25	Oct	2014	187	245	31.02%
25	Oct	2014	186	277	48.92%
25	Oct	2014	127	187	47.24%
25	Oct	2014	127	224	76.38%
25	Oct	2014	127	196	54.33%
26	Nov	2014	187	263	40.64%
26	Nov	2014	127	204	60.63%
26	Nov	2014	127	199	56.69%
26	Nov	2014	125	201	60.80%
26	Nov	2014	188	260	38.30%
27	Dec	2014	125	204	63.20%
27	Dec	2014	127	203	59.84%
27	Dec	2014	186	268	44.09%
27	Dec	2014	128	196	53.13%
27	Dec	2014	126	204	61.90%
28	Jan	2015	187	275	47.06%
28	Jan	2015	127	217	70.87%
28	Jan	2015	125	217	73.60%
28	Jan	2015	188	282	50.00%
29	Feb	2015	125	253	102.40%
29	Feb	2015	128	218	70.31%
29	Feb	2015	128	220	71.88%
29	Feb	2015	129	219	69.77%
29	Feb	2015	186	277	48.92%
29	Feb	2015	126	214	69.84%
30	Mar	2015	168	252	50.00%
30	Mar	2015	186	269	44.62%
30	Mar	2015	136	199	46.32%
30	Mar	2015	96	193	101.04%
30	Mar	2015	217	260	19.82%
30	Mar	2015	138	198	43.48%
30	Mar	2015	197	275	39.59%
31	Apr	2015	128	236	84.38%
31	Apr	2015	136	199	46.32%
31	Apr	2015	134	130	-2.99%
31	Apr	2015	135	129	-4.44%
31	Apr	2015	196	272	38.78%

31	Apr	2015	171	220	28.65%
31	Apr	2015	137	215	56.93%
31	Apr	2015	195	267	36.92%
32	May	2015	127	118	-7.09%
32	May	2015	198	253	27.78%
32	May	2015	125	120	-4.00%
32	May	2015	171	265	54.97%
32	May	2015	198	254	28.28%
32	May	2015	127	117	-7.87%
32	May	2015	125	129	3.20%
33	Jun	2015	126	117	-7.14%
33	Jun	2015	125	130	4.00%
33	Jun	2015	125	124	-0.80%
33	Jun	2015	186	168	-9.68%
33	Jun	2015	126	126	0.00%
34	Jul	2015	125	124	-0.80%
34	Jul	2015	125	128	2.40%
34	Jul	2015	184	173	-5.98%
34	Jul	2015	125	119	-4.80%
34	Jul	2015	127	124	-2.36%
34	Jul	2015	189	162	-14.29%
35	Aug	2015	137	122	-10.95%
35	Aug	2015	131	119	-9.16%
35	Aug	2015	185	170	-8.11%
35	Aug	2015	125	119	-4.80%
35	Aug	2015	126	126	0.00%
35	Aug	2015	233	233	0.00%
35	Aug	2015	185	162	-12.43%
35	Aug	2015	128	114	-10.94%
36	Sep	2015	127	114	-10.24%
36	Sep	2015	185	161	-12.97%
36	Sep	2015	127	123	-3.15%
36	Sep	2015	186	165	-11.29%
36	Sep	2015	126	135	7.14%
37	Oct	2015	125	125	0.00%
37	Oct	2015	126	121	-3.97%
37	Oct	2015	186	172	-7.53%
37	Oct	2015	127	120	-5.51%
37	Oct	2015	187	170	-9.09%
38	Nov	2015	140	140	0.00%

38	Nov	2015	125	134	7.20%
38	Nov	2015	125	118	-5.60%
38	Nov	2015	130	119	-8.46%
38	Nov	2015	187	173	-7.49%
38	Nov	2015	127	121	-4.72%
39	Dec	2015	125	128	2.40%
39	Dec	2015	186	176	-5.38%
39	Dec	2015	152	148	-2.63%
39	Dec	2015	135	131	-2.96%
39	Dec	2015	141	135	-4.26%
40	Jan	2016	137	151	10.22%
40	Jan	2016	141	149	5.67%
40	Jan	2016	407	513	26.04%
40	Jan	2016	136	147	8.09%
40	Jan	2016	136	152	11.76%
40	Jan	2016	135	149	10.37%
40	Jan	2016	197	181	-8.12%
41	Feb	2016	141	145	2.84%
41	Feb	2016	135	140	3.70%
41	Feb	2016	297	302	1.68%
41	Feb	2016	165	172	4.24%
42	Mar	2016	135	162	20.00%
42	Mar	2016	134	144	7.46%
42	Mar	2016	132	140	6.06%
42	Mar	2016	135	143	5.93%
42	Mar	2016	196	214	9.18%
42	Mar	2016	196	204	4.08%
42	Mar	2016	196	196	0.00%
43	Apr	2016	141	162	14.89%
43	Apr	2016	136	161	18.38%
43	Apr	2016	141	166	17.73%
43	Apr	2016	135	161	19.26%
43	Apr	2016	136	160	17.65%
43	Apr	2016	302	302	0.00%
43	Apr	2016	141	158	12.06%
44	May	2016	135	155	14.81%
44	May	2016	135	155	14.81%
44	May	2016	302	307	1.66%
44	May	2016	126	148	17.46%
45	Jun	2016	141	169	19.86%

45	Jun	2016	205	241	17.56%
45	Jun	2016	125	150	20.00%
45	Jun	2016	141	193	36.88%
45	Jun	2016	131	166	26.72%
45	Jun	2016	132	170	28.79%
46	Jul	2016	129	157	21.71%
46	Jul	2016	124	162	30.65%
46	Jul	2016	135	157	16.30%
46	Jul	2016	125	151	20.80%
46	Jul	2016	139	135	-2.88%
46	Jul	2016	139	130	-6.47%
47	Aug	2016	126	129	2.38%
47	Aug	2016	138	136	-1.45%
47	Aug	2016	137	130	-5.11%
47	Aug	2016	126	197	56.35%
47	Aug	2016	254	275	8.27%
47	Aug	2016	139	141	1.44%
48	Sep	2016	125	142	13.60%
48	Sep	2016	136	135	-0.74%
48	Sep	2016	136	130	-4.41%
48	Sep	2016	159	127	-20.13%
49	Oct	2016	139	140	0.72%
49	Oct	2016	125	146	16.80%
49	Oct	2016	125	133	6.40%
49	Oct	2016	137	133	-2.92%
49	Oct	2016	235	253	7.66%
50	Nov	2016	139	133	-4.32%
50	Nov	2016	155	145	-6.45%
50	Nov	2016	126	134	6.35%
50	Nov	2016	126	134	6.35%
50	Nov	2016	126	131	3.97%
51	Dec	2016	125	155	24.00%
51	Dec	2016	125	143	14.40%
51	Dec	2016	140	137	-2.14%
51	Dec	2016	136	136	0.00%
51	Dec	2016	138	139	0.72%
51	Dec	2016	135	129	-4.44%
52	Jan	2017	214	323	50.93%
52	Jan	2017	135	142	5.19%
53	Feb	2017	158	158	0.00%

53	Feb	2017	135	148	9.63%
53	Feb	2017	191	272	42.41%
54	Mar	2017	136	172	26.47%
54	Mar	2017	135	170	25.93%
54	Mar	2017	147	162	10.20%
54	Mar	2017	146	162	10.96%
55	Apr	2017	145	163	12.41%
55	Apr	2017	146	174	19.18%
55	Apr	2017	146	169	15.75%
55	Apr	2017	145	163	12.41%
55	Apr	2017	229	237	3.49%
55	Apr	2017	146	175	19.86%
56	May	2017	197	371	88.32%
56	May	2017	135	183	35.56%
56	May	2017	146	182	24.66%
56	May	2017	127	165	29.92%
56	May	2017	134	162	20.90%
57	Jun	2017	146	174	19.18%
57	Jun	2017	135	204	51.11%
57	Jun	2017	146	198	35.62%
57	Jun	2017	160	154	-3.75%
57	Jun	2017	167	188	12.57%
57	Jun	2017	135	168	24.44%
58	Jul	2017	161	169	4.97%
58	Jul	2017	126	169	34.13%
58	Jul	2017	217	384	76.96%
58	Jul	2017	138	175	26.81%
58	Jul	2017	151	167	10.60%
59	Aug	2017	127	144	13.39%
59	Aug	2017	136	155	13.97%
59	Aug	2017	125	189	51.20%
59	Aug	2017	138	181	31.16%
59	Aug	2017	201	373	85.57%
59	Aug	2017	137	166	21.17%
59	Aug	2017	159	210	32.08%
60	Sep	2017	159	202	27.04%
60	Sep	2017	161	192	19.25%
60	Sep	2017	136	177	30.15%
60	Sep	2017	194	253	30.41%
60	Sep	2017	136	182	33.82%

60	Sep	2017	134	162	20.90%
60	Sep	2017	161	180	11.80%
60	Sep	2017	136	166	22.06%
61	Oct	2017	159	188	18.24%
61	Oct	2017	126	169	34.13%
61	Oct	2017	160	197	23.13%
61	Oct	2017	161	177	9.94%
61	Oct	2017	127	173	36.22%
61	Oct	2017	159	173	8.81%
61	Oct	2017	125	153	22.40%
62	Nov	2017	159	167	5.03%
62	Nov	2017	137	183	33.58%
62	Nov	2017	136	150	10.29%
62	Nov	2017	159	164	3.14%
62	Nov	2017	160	190	18.75%
63	Dec	2017	160	185	15.63%
63	Dec	2017	170	155	-8.82%
64	Jan	2018	138	183	32.61%
64	Jan	2018	170	197	15.88%
64	Jan	2018	196	210	7.14%
64	Jan	2018	136	178	30.88%
64	Jan	2018	169	184	8.88%
64	Jan	2018	156	175	12.18%
64	Jan	2018	146	156	6.85%
64	Jan	2018	169	178	5.33%
65	Feb	2018	135	166	22.96%
65	Feb	2018	205	229	11.71%
65	Feb	2018	187	198	5.88%
65	Feb	2018	208	217	4.33%
65	Feb	2018	158	196	24.05%
66	Mar	2018	145	186	28.28%
66	Mar	2018	147	186	26.53%
66	Mar	2018	169	185	9.47%
66	Mar	2018	169	183	8.28%
66	Mar	2018	169	180	6.51%
66	Mar	2018	2	2	0.00%
66	Mar	2018	138	197	42.75%
67	Apr	2018	174	174	0.00%
67	Apr	2018	169	169	0.00%
67	Apr	2018	225	225	0.00%

67	Apr	2018	204	191	-6.37%
67	Apr	2018	148	181	22.30%
67	Apr	2018	154	165	7.14%
67	Apr	2018	135	182	34.81%
68	May	2018	135	168	24.44%
68	May	2018	184	184	0.00%
68	May	2018	144	171	18.75%
69	Jun	2018	186	186	0.00%
69	Jun	2018	135	218	61.48%
69	Jun	2018	149	174	16.78%
69	Jun	2018	141	152	7.80%
69	Jun	2018	127	147	15.75%
69	Jun	2018	128	174	35.94%
69	Jun	2018	149	149	0.00%
69	Jun	2018	135	135	0.00%
69	Jun	2018	163	163	0.00%
69	Jun	2018	165	197	19.39%
70	Jul	2018	149	149	0.00%
70	Jul	2018	138	132	-4.35%
71	Aug	2018	172	172	0.00%
71	Aug	2018	158	158	0.00%
71	Aug	2018	196	156	-20.41%
71	Aug	2018	195	195	0.00%
71	Aug	2018	165	165	0.00%
72	Sep	2018	212	212	0.00%
72	Sep	2018	153	153	0.00%
72	Sep	2018	134	134	0.00%
72	Sep	2018	153	153	0.00%
73	Oct	2018	199	199	0.00%
73	Oct	2018	154	154	0.00%
73	Oct	2018	201	201	0.00%
74	Nov	2018	195	230	17.95%
74	Nov	2018	149	214	43.62%
74	Nov	2018	261	267	2.30%
74	Nov	2018	150	182	21.33%
74	Nov	2018	134	163	21.64%
75	Dec	2018	156	186	19.23%
75	Dec	2018	192	192	0.00%
75	Dec	2018	135	155	14.81%
75	Dec	2018	232	232	0.00%

76	Jan	2019	183	183	0.00%
76	Jan	2019	169	195	15.38%
76	Jan	2019	205	201	-1.95%
76	Jan	2019	163	163	0.00%
77	Feb	2019	305	305	0.00%
78	Mar	2019	220	220	0.00%
78	Mar	2019	205	205	0.00%
78	Mar	2019	192	192	0.00%
79	Apr	2019	222	222	0.00%
79	Apr	2019	255	255	0.00%
80	May	2019	229	229	0.00%
81	Jun	2019	273	259	-5.13%
81	Jun	2019	60	60	0.00%
82	Jul	2019	231	231	0.00%
82	Jul	2019	287	287	0.00%
83	Aug	2019	173	230	32.95%
83	Aug	2019	270	254	-5.93%
83	Aug	2019	188	240	27.66%
84	Sep	2019	190	222	16.84%
84	Sep	2019	242	212	-12.40%
85	Oct	2019	266	266	0.00%
85	Oct	2019	317	327	3.15%
86	Nov	2019	233	392	68.24%
86	Nov	2019	171	259	51.46%
87	Dec	2019	186	208	11.83%
87	Dec	2019	373	373	0.00%
88	Jan	2020	186	177	-4.84%
88	Jan	2020	185	173	-6.49%
89	Feb	2020	367	462	25.89%
89	Feb	2020	396	396	0.00%
90	Mar	2020	196	196	0.00%
90	Mar	2020	189	189	0.00%
90	Mar	2020	484	540	11.57%
91	Apr	2020	431	431	0.00%
91	Apr	2020	205	177	-13.66%
92	May	2020	205	183	-10.73%
93	Jun	2020	561	561	0.00%
93	Jun	2020	205	188	-8.29%
93	Jun	2020	148	141	-4.73%
94	Jul	2020	213	213	0.00%

94	Jul	2020	195	178	-8.72%
95	Aug	2020	847	847	0.00%
95	Aug	2020	246	195	-20.73%
96	Sep	2020	148	117	-20.95%
96	Sep	2020	199	199	0.00%
96	Sep	2020	195	175	-10.26%
97	Oct	2020	637	637	0.00%
97	Oct	2020	195	195	0.00%
98	Nov	2020	195	194	-0.51%
98	Nov	2020	719	719	0.00%
99	Dec	2020	205	205	0.00%
99	Dec	2020	148	135	-8.78%
99	Dec	2020	205	203	-0.98%
100	Jan	2021	205	196	-4.39%
101	Feb	2021	232	232	0.00%
101	Feb	2021	221	221	0.00%
102	Mar	2021	927	927	0.00%
102	Mar	2021	205	197	-3.90%
102	Mar	2021	816	816	0.00%
102	Mar	2021	155	142	-8.39%
102	Mar	2021	1028	1028	0.00%
103	Apr	2021	155	145	-6.45%
103	Apr	2021	231	231	0.00%
103	Apr	2021	165	165	0.00%
104	May	2021	155	152	-1.94%
104	May	2021	155	148	-4.52%
104	May	2021	1269	1269	0.00%
105	Jun	2021	180	180	0.00%
105	Jun	2021	283	283	0.00%
106	Jul	2021	267	267	0.00%
106	Jul	2021	146	190	30.14%
106	Jul	2021	250	239	-4.40%
106	Jul	2021	284	284	0.00%
107	Aug	2021	433	408	-5.77%

Appendix E: Production Hours Variable Data

Period	Month	CY	FY	Actual Hours	Target Hours	PH Performance Indicator (%)
1	Oct	2012	2013	58876.0	58795.4	0.14%
2	Nov	2012	2013	48862.4	48862.4	0.00%
3	Dec	2012	2013	38395.9	42826.2	-10.34%
4	Jan	2013	2013	49597.9	49769.8	-0.35%
5	Feb	2013	2013	55293.4	47595.4	16.17%
6	Mar	2013	2013	52616.9	54255.1	-3.02%
7	Apr	2013	2013	47036.6	53077.9	-11.38%
8	May	2013	2013	45092.1	64096.9	-29.65%
9	Jun	2013	2013	54527.2	51530.7	5.81%
10	Jul	2013	2013	37883.4	64298.8	-41.08%
11	Aug	2013	2013	33566.4	64384.2	-47.87%
12	Sep	2013	2013	45938.2	55140.5	-16.69%
13	Oct	2013	2014	59123.4	55152.7	7.20%
14	Nov	2013	2014	45513.4	36914.6	23.29%
15	Dec	2013	2014	39927.1	46498.9	-14.13%
16	Jan	2014	2014	36310.4	42881.1	-15.32%
17	Feb	2014	2014	32225.0	40550.2	-20.53%
18	Mar	2014	2014	38896.0	46505.7	-16.36%
19	Apr	2014	2014	49023.1	48527.8	1.02%
20	May	2014	2014	49291.4	52987.9	-6.98%
21	Jun	2014	2014	54121.2	52213.1	3.65%
22	Jul	2014	2014	49793.4	56637.4	-12.08%
23	Aug	2014	2014	62680.7	55925.1	12.08%
24	Sep	2014	2014	55604.6	55105.5	0.91%
25	Oct	2014	2015	53405.2	55354.8	-3.52%
26	Nov	2014	2015	41394.2	39981.5	3.53%
27	Dec	2014	2015	44669.7	39865.9	12.05%
28	Jan	2015	2015	44313.5	46958.4	-5.63%
29	Feb	2015	2015	54706.9	49487.9	10.55%
30	Mar	2015	2015	70830.3	55701.6	27.16%
31	Apr	2015	2015	63568.5	54034.4	17.64%
32	May	2015	2015	59490.8	54541.2	9.07%
33	Jun	2015	2015	66205.3	56504.9	17.17%
34	Jul	2015	2015	59660.6	56031.8	6.48%

35	Aug	2015	2015	64208.2	55857.0	14.95%
36	Sep	2015	2015	60586.6	56837.9	6.60%
37	Oct	2015	2016	52426.9	45202.9	15.98%
38	Nov	2015	2016	44451.4	37903.4	17.28%
39	Dec	2015	2016	50447.3	38458.1	31.17%
40	Jan	2016	2016	46329.2	43200.9	7.24%
41	Feb	2016	2016	43675.6	48230.7	-9.44%
42	Mar	2016	2016	49482.1	52868.6	-6.41%
43	Apr	2016	2016	43239.0	49334.1	-12.35%
44	May	2016	2016	40417.0	51365.1	-21.31%
45	Jun	2016	2016	44063.2	54137.3	-18.61%
46	Jul	2016	2016	47953.1	46868.1	2.32%
47	Aug	2016	2016	48701.5	57042.2	-14.62%
48	Sep	2016	2016	39723.9	52119.7	-23.78%
49	Oct	2016	2017	38048.9	41912.9	-9.22%
50	Nov	2016	2017	38445.0	44000.3	-12.63%
51	Dec	2016	2017	37368.7	44041.8	-15.15%
52	Jan	2017	2017	40977.3	46648.9	-12.16%
53	Feb	2017	2017	40140.3	43361.2	-7.43%
54	Mar	2017	2017	49753.9	51782.8	-3.92%
55	Apr	2017	2017	47210.3	43966.6	7.38%
56	May	2017	2017	53449.4	55441.5	-3.59%
57	Jun	2017	2017	51176.7	52814.9	-3.10%
58	Jul	2017	2017	47510.0	42752.3	11.13%
59	Aug	2017	2017	57903.5	55573.5	4.19%
60	Sep	2017	2017	48070.2	46161.6	4.13%
61	Oct	2017	2018	47261.4	43895.3	7.67%
62	Nov	2017	2018	44678.2	43647.9	2.36%
63	Dec	2017	2018	40764.0	40436.2	0.81%
64	Jan	2018	2018	45775.9	48313.0	-5.25%
65	Feb	2018	2018	47988.7	44481.4	7.88%
66	Mar	2018	2018	48409.6	47801.2	1.27%
67	Apr	2018	2018	48347.4	46102.0	4.87%
68	May	2018	2018	41817.8	53583.1	-21.96%
69	Jun	2018	2018	44055.0	49064.5	-10.21%
70	Jul	2018	2018	39275.1	45948.4	-14.52%
71	Aug	2018	2018	41221.0	53866.0	-23.47%
72	Sep	2018	2018	35329.9	42555.9	-16.98%
73	Oct	2018	2019	42418.7	49821.2	-14.86%
74	Nov	2018	2019	34634.6	44790.1	-22.67%

75	Dec	2018	2019	29594.8	38854.3	-23.83%
76	Jan	2019	2019	28313.3	42606.1	-33.55%
77	Feb	2019	2019	14835.0	42371.9	-64.99%
78	Mar	2019	2019	19432.9	44576.0	-56.41%
79	Apr	2019	2019	18969.9	49825.4	-61.93%
80	May	2019	2019	19974.7	50427.1	-60.39%
81	Jun	2019	2019	22218.4	45358.7	-51.02%
82	Jul	2019	2019	19799.4	52331.1	-62.17%
83	Aug	2019	2019	22266.2	49863.3	-55.35%
84	Sep	2019	2019	23046.4	48089.3	-52.08%
85	Oct	2019	2020	18649.5	20761.1	-10.17%
86	Nov	2019	2020	14940.3	19183.5	-22.12%
87	Dec	2019	2020	16709.3	19214.6	-13.04%
88	Jan	2020	2020	23138.3	19867.3	16.46%
89	Feb	2020	2020	21542.2	22251.0	-3.19%
90	Mar	2020	2020	19032.1	25460.2	-25.25%
91	Apr	2020	2020	16348.3	25960.4	-37.03%
92	May	2020	2020	16161.6	24232.8	-33.31%
93	Jun	2020	2020	23050.5	25831.7	-10.77%
94	Jul	2020	2020	19412.5	27055.4	-28.25%
95	Aug	2020	2020	26390.0	27703.2	-4.74%
96	Sep	2020	2020	24517.5	29316.4	-16.37%
97	Oct	2020	2021	26242.4	27730.4	-5.37%
98	Nov	2020	2021	24289.0	26809.5	-9.40%
99	Dec	2020	2021	23439.8	30922.6	-24.20%
100	Jan	2021	2021	28564.5	24449.4	16.83%
101	Feb	2021	2021	28393.7	29531.5	-3.85%
102	Mar	2021	2021	33928.1	32631.1	3.97%
103	Apr	2021	2021	34003.2	35377.5	-3.88%
104	May	2021	2021	31388.7	27077.5	15.92%
105	Jun	2021	2021	33489.2	35379.5	-5.34%
106	Jul	2021	2021	29321.5	33496.2	-12.46%
107	Aug	2021	2021	30228.4	34210.6	-11.64%

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14. ABSTRACT
In the United States, 10,000 baby boomers turn 65 every day. The subsequent generation born between 1965 and 1976 is significantly smaller, referred to as the baby bust. As a result, this causes a talent shortage as Baby Boomers retire, leaving a workforce gap which the subsequent generation is not large enough to fill. This issue also has been recognized as a potential problem in the logistics community of the United States Air Force. The purpose of this study is to examine the impact of workers' age on key logistics performance indicators (LPIs) such as aircraft availability, product flow days, and production hours. This study finds that significant relationships exist between average employee age and certain LPIs.

15. SUBJECT TERMS
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