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## **Case 2 - Baggage Complaints:** Descriptive Statistics and Time Series Plots

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## Baggage Complaints: Descriptive Statistics and Time Series Plots

### Background

Anyone who travels by air knows that occasional problems are inevitable. Flights can be delayed or cancelled due to weather conditions, mechanical problems, or labor strikes, and baggage can be lost, delayed, damaged, or pilfered. Given that many airlines are now charging for bags, issues with baggage are particularly annoying. Baggage problems can have a serious impact on customer loyalty, and can be costly to the airlines (airlines often have to deliver bags).

Air carriers report flight delays, cancellations, overbookings, late arrivals, baggage complaints, and other operating statistics to the U.S. government, which compiles the data and reports it to the public.

### The Task

Do some airlines do a better job of handling baggage? Compare the baggage complaints for three airlines: American Eagle, Hawaiian, and United. Which airline has the best record? The worst? Are complaints getting better or worse over time? Are there other factors, such as destinations, seasonal effects or the volume of travelers that affect baggage performance?

### The Data [Baggage Complaints.jmp](#)

The data set contains monthly observations from 2004 to 2010 for United Airlines, American Eagle, and Hawaiian Airlines. The variables in the data set include:

<b>Baggage</b>	The total number of passenger complaints for theft of baggage contents, or for lost, damaged, or misrouted luggage for the airline that month
<b>Scheduled</b>	The total number of flights scheduled by that airline that month
<b>Cancelled</b>	The total number of flights cancelled by that airline that month
<b>Enplaned</b>	The total number of passengers who boarded a plane with the airline that month

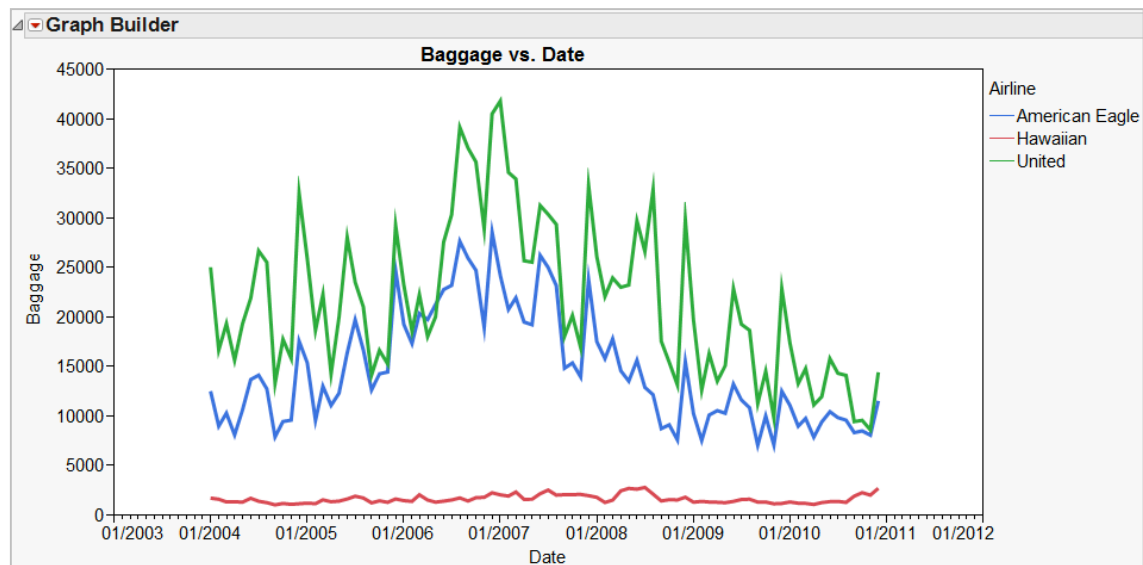
These data are available from the U.S. Department of Transportation, "Air Travel Consumer Report," the Office of Aviation Enforcement and Proceedings, Aviation Consumer Protection Division (<http://airconsumer.dot.gov/reports/index.htm>). The data for baggage complaints and enplaned passengers cover domestic travel only.

## Analysis

We start by exploring baggage complaints over time.

Exhibit 1 shows the time series plot for the variable **Baggage** by Date for each of the airlines. United Airlines has the most complaints about mishandled baggage in almost all of the months in the data set; Hawaiian Airlines has the fewest number of complaints in all months. Do we conclude, then, that United Airlines has the “worst record” for mishandled baggage and Hawaiian, the best?

**Exhibit 1** Time Series Plots of **Baggage** by **Airline**



(Graph > Graph Builder; drag and drop **Baggage** in Y, **Date** in X and **Airline** in Overlay. Click on the smoother icon at the top to remove the smoother, and click on the line icon. Or, right-click in the graph, and select Smoother > Remove, and Points > Change to > Line. Then, click Done.)

United Airlines is a much bigger airline, as evidenced by Exhibit 2, which shows the average number of scheduled flights and enplaned passengers by airline. United handles more than three times the number of passengers than American Eagle on average, and almost eight times more than Hawaiian. Thus, United has more opportunities to mishandle luggage because it handles more luggage – it’s simply a much bigger airline.

**Exhibit 2** Average **Scheduled** Flights and **Enplaned** Passengers by **Airline**

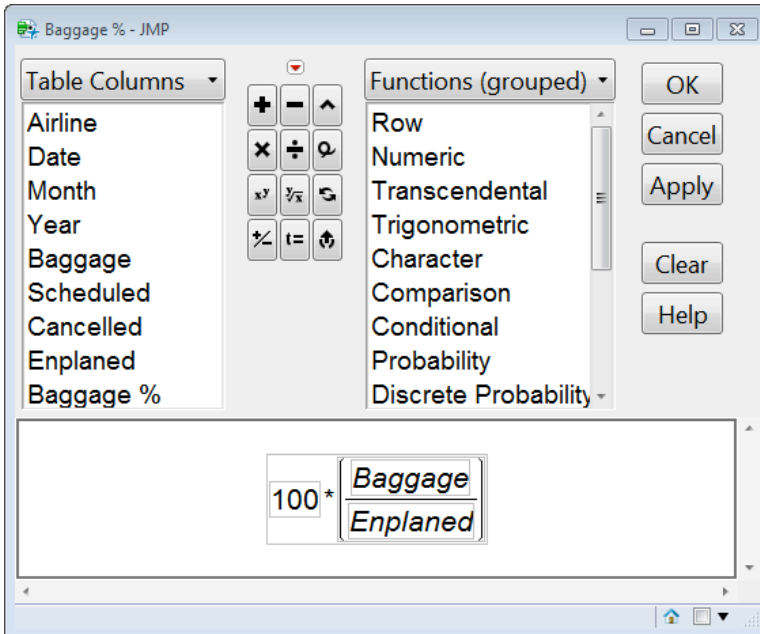
	Scheduled	Enplaned
Airline	Mean	Mean
American Eagle	41314	1396726
Hawaiian	4845	594174
United	38225	4620712

(Analyze > Tabulate; drag **Airline** in drop zone for rows, and **Scheduled** and **Enplaned** in the drop zone for column as analysis columns. Then, drag **Mean** from the middle panel to the middle of the table.

Note that in JMP versions 10 and earlier Tabulate is under the Tables menu.)

To adjust for size we calculate the rate of baggage complaints (Exhibit 3): **Baggage %** =  $100 \times (\text{Baggage}/\text{Enplaned})$ .

**Exhibit 3** Calculating **Baggage %**



(Create a new column in the data table, and rename it **Baggage %**. Right click on the column header, and select Formula to open the Formula Editor. To create the formula:

1. Type 100
2. Select multiply on the keypad
3. Select Baggage from the columns list
4. Select divide by on the keypad
5. Select Enplaned from the columns list
6. Click OK.)

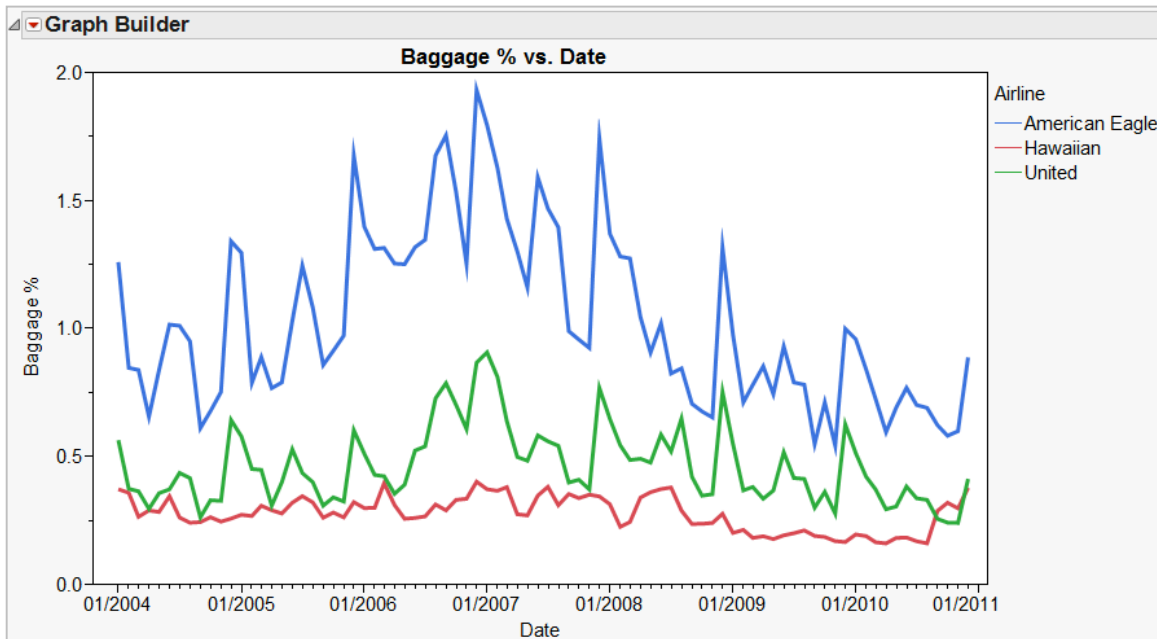
In Exhibit 4 we compare the records of the three airlines using **Baggage %**. We see that American Eagle has the highest rate of baggage complaints when adjusted for number of enplaned passengers.

**Exhibit 4** Average **Baggage %** by Airline

	<b>Baggage %</b>
<b>Airline</b>	<b>Mean</b>
American Eagle	1.033
Hawaiian	0.277
United	0.464

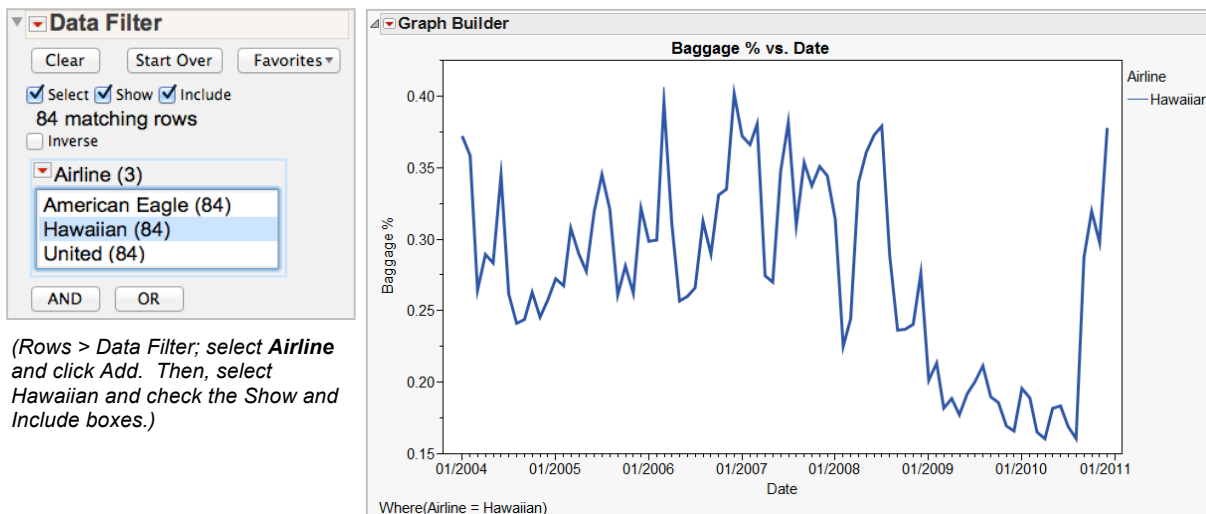
Plotting the **Baggage %** on a time series plot allows us to see changes over time. In Exhibit 5 we see that baggage complaint rates from American Eagle and United passengers increased through 2006 and began declining thereafter.

**Exhibit 5** Time Series Plots of **Baggage %** by **Airline**



The time series for Hawaiian passengers in Exhibit 5 is relatively flat compared to American Eagle and United, so it's difficult to detect a pattern over time. In Exhibit 6 we isolate the data for the Hawaiian flights. Complaint rates for Hawaiian passengers began to drop in the summer of 2008 until fall of 2010, after which the rate of complaints returned to historical levels.

**Exhibit 6** Data Filter and Time Series Plot of **Baggage %** - Hawaiian Airline

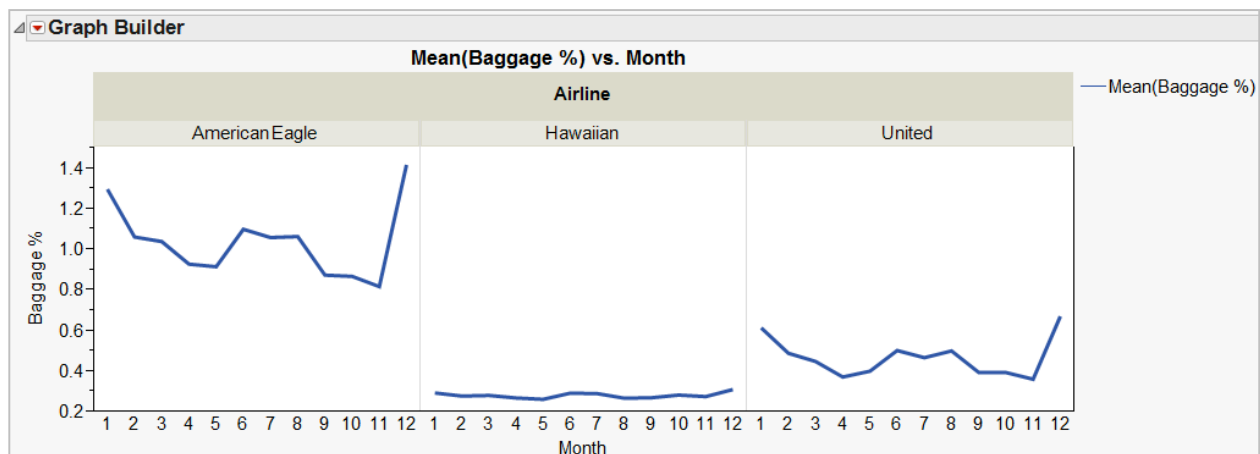


(Rows > Data Filter; select **Airline** and click Add. Then, select **Hawaiian** and check the Show and Include boxes.)

Let's return to Exhibit 5: Do we see any other patterns in baggage complaint rates over time? The pattern of spikes and dips indicates that changes in the rate of baggage complaints may have a seasonal component. In Exhibit 7 we plot the average **Baggage %** by month for the three airlines to investigate this further.

Average rates are highest in December and January and in the summer months, and lowest in the spring and late fall. Interestingly, all three airlines seem to follow the same general pattern. (Using the Data Filter to zoom in on Hawaiian will make this more apparent.)

**Exhibit 7** Time Series Plots of Monthly Average **Baggage %** by **Airline**



(Graph > Graph Builder; drag and drop **Baggage %** in Y, **Month** in X and **Airline** in Group X. Then, click on the line icon at the top. Or, right-click in the graph, and select Points > Change to > Line. Then, click Done.)

## Summary

### Statistical Insights

It is important to ask a lot of pointed questions about the purpose and scope of a project before jumping into data analysis. How will the results be used? And, is the information available to answer the questions being asked? The data set provided did not have information on flight destinations, so we are not able to investigate whether destination is related to baggage issues.

To provide a fair comparison of performance across airlines, it's best to standardize for differences in volume. It is also important to pay close attention to units of measurement, as will be seen in an exercise.

### Managerial Implications

When asking a data analyst to conduct a study, ensure that the purpose is clear. What, specifically, do you want to know? And, how will the information provided by the analyst be used to guide the decision-making process?

What did we learn from the analysis? Managers at American Eagle should note the relatively high rate of baggage complaints and consider costs and benefits of improvements. All three airlines

should anticipate high rates of baggage complaints in January, February and the summer months and should plan accordingly. If we are interested in studying baggage complaints for different destinations, additional data are required.

### **JMP Features and Hints**

This case uses the Graph Builder to compare multiple time series and Tabulate to produce summary statistics by groups. Data Filter is used with the Graph Builder to further investigate a particular group.

### **Exercises**

1. Exhibit 4 shows that the average **Baggage %** for American Eagle is 1.033. Provide a nontechnical interpretation of this number by using it in this sentence: "1.033 is the..." Pay particular attention to units of measurement.
2. Use Tabulate to calculate the standard deviations of **Baggage %** for each airline. Provide a non-technical interpretation of the standard deviations. Is one airline more variable than the others?
3. Compare the three airlines based on cancelled flights: Which airline has the best record? The worst?



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