JMP Instructional data set 005

Manufacturing Lines: Non-Operational Reasons

JMP STATISTICAL DISCOVERY

JMP platforms and statistical method

Quality and Process: Pareto plot
Formula Editor: Creating new variables
Graph Builder: Bar chart

Problem statement

The quality team at a company that manufactures insulation material used in industrial applications is concerned about the amount of time its three main production lines are non-operational due to needed repairs and maintenance.

The team has decided that a helpful first step is to summarize these non-operational events with a simple set of graphs and statistics so that management and other relevant teams in the company can have an accurate view into this issue. Data from the past 10 month has been gathered and summarized into a data table that includes the frequency each of the lines was non-operational, the reason, and the number of hours until the line was running again.

Data

IDS_005.jmp

Line	Production Line (A, B, C)
Reasons	Reason the line was non-operational (19 categories)
Frequency	Number of times during the past 10 months the line was non-operational for each reason.
Downtime	Total number of hours the line was non-operational for each reason

Exercises

The exercises will have you first create a variety of interactive visualizations. You'll then explore the data through these visualizations to find and describe features to produce insights into performance of the students in these grades and subjects across the country and over time.

1. Create a Pareto Plot displaying the number of times the lines were non-operational for each of the 19 reasons. What are the top 5 reasons that the lines were non-operational? What percentage of all the times the lines were non-operational was because of these top 5 reasons?

> ***Instructions:***
> *Analyze > Quality and Process > Pareto Plot. Place 'Reason' in the Y,Cause Role, Place 'Frequency' in the Freq Role. Click OK.*
> *Select Cumulative Percent > Label Cum Percent Points in the Red Triangle menu next to the title Plots.*

2. Add a Data Filter to the Pareto Plot created in Exercise 1 allowing for the ability to select individual production lines. What are the top 5 reasons that each line was non-operational? What percentage of all the times each line was non-operational was because of the top 5 reasons? Which reasons are in the top 5 for individual lines but not in the top 5 overall?

> ***Instructions:***
> *Select Local Data Filter under the Red Triangle. Select 'Line' as the filter variable. The Data Filter will now appear allowing you to select a specific line for the Pareto Plot.*

3. Create a Pareto Plot displaying the amount of time the lines were non-operational for each of the 19 reasons. What are the top 5 reasons that resulted in the lines being non-operational for the most amount of time? What percentage of the total downtime was because of these top 5 reasons? How do these results compare to your analysis on the frequency the lines were non-operational in Exercise 1?

Instructions:
Analyze > Quality and Process > Pareto Plot. Place 'Reason' in the Y,Cause Role, Place 'Downtime' in the Freq Role. Click OK.
Select Cumulative Percent > Label Cum Percent Points in the Red Triangle menu next to the title Plots.

4. Add a Data Filter to the Pareto Plot created in Exercise 3 allowing for the ability to select individual production lines. What are the top 5 reasons that resulted in each of the lines being non-operational for the most amount of time? What percentage of the total downtime was because of these top 5 reasons? Which reasons are in the top 5 for individual lines but not in the top 5 overall? How do these results compare to your analysis on the frequency of times the lines were down? How do these results compare to your analysis on the frequency of times each of the lines were down in Exercise 2?

Instructions:
Select Local Data Filter under the Red Triangle. Select 'Line' as the filter variable. The Data Filter will now appear allowing you to select a specific line for the Pareto Plot.

5. Create a comparative side-by-side Bar Chart displaying the frequency each of the lines were non-operational for the 19 reasons. Identify a few reasons where there's a large difference in the frequency of non-operational events between the lines. Identify a few reasons where the frequency is similar across the lines.

Instructions:
Graph > Graph Builder. Place 'Frequency' in the Y role, 'Reasons' in the X role, 'Line' in the Overlay role. Choose the Bar Chart icon in the graph palette. 

Right-click on the X axis and choose Order by > Frequency, descending. The Reasons are now ordered from highest 'Frequency' cumulative across the lines to lowest.

Choosing Stacked for Bar Style is an alternative way to view the data.

6. Create a comparative side-by-side Bar Chart displaying the amount of time each of the lines were non-operational for the 19 reasons. Identify a few reasons where there's a large difference in the amount of downtime between the lines. Identify a few reasons where the amount of downtime is similar across the lines.

Instructions:
Repeat the same steps as in Exercise 5 using 'Downtime' in the Y Role.

7. Create a new variable that is the average amount of time the line is non-operational for each reason.

Instructions:
Create a new column (Cols > New Columns). In the New Column dialog box, choose Formula in the Column Properties drop down menu. Select Edit Formula. In the Formula Editor, create the formula:

$$\frac{Downtime}{Frequency}$$

Name the new column 'Avg Downtime'.

8. Create a Bar Chart displaying the average downtime for each reason across all lines in aggregate. What are the top 5 reasons having the largest average downtime? What are the 5 reasons with the smallest average downtime?

Instructions:
Graph > Graph Builder. Place 'Avg Downtime' in the Y role, 'Reasons' in the X role, Choose the Bar Chart icon in the graph palette. 

Right-click on the X axis and choose Order by > Frequency, descending.

9. Create a comparative side-by-side Bar Chart displaying the average downtime for each line. Summarize a few insights this graph reveals.

Instructions:
Graph > Graph Builder. Place 'Avg Downtime' in the Y role, 'Reasons' in the X role, 'Line' in the Overlay role. Choose the Bar Chart icon in the graph palette. 

Right-click on the X axis and choose Order by > Frequency, descending. The Reasons are now ordered from highest 'Frequency' cumulative across the lines to lowest.

Choosing Stacked for Bar Style is an alternative way to view the data.

10. What are some next steps the quality team can take to improve performance of these production lines? What other data would be helpful to examine? What are some possible reasons why the lines do not perform similarly regarding the frequency and amount of time they're non-operational?