Minitab® 17



What You'll Need

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TIME SERIES PLOT AND ONE-WAY ANOVA Can You Count On Weather Forecasts?

People consult weather forecasts to determine their activities, what to wear, or what to pack for a trip. But are these predictions trustworthy, or just a lot of hot air?

You can use the Assistant in Minitab Statistical Software to find out.

Try It Yourself

The data set collects 30 days' worth of next-day, 5-day, and 10-day high temperature forecasts (in degrees F) for State College, Pennsylvania—the home of Minitab's World Headquarters. The data sheet also includes the actual high temperature for each day, and the differences between the forecasted and actual high temperatures.

Date	10 day	5 day	next day	high	10-diff	5-diff	next-diff
May 12	69	77	77	77	-8	0	0
May 13	65	70	67	66	-1	4	1
May 14	64	64	63	63	1	1	0
May 15	65	66	<mark>6</mark> 6	68	-3	-2	-2
May 16	68	67	61	64	4	3	-3
May 17	69	59	62	61	8	-2	1
May 18	67	66	66	64	3	2	2
May 19	67	66	66	66	1	0	0
May 20	70	70	69	70	0	0	-1
May 21	70	78	77	75	-5	3	2
May 22	76	82	78	72	4	10	6
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Step 1: See the Data

Graphing your data is always a good first step. Select **Assistant > Graphical Analysis...** for guidance on what graphs might offer insight about this data.

<u>M</u> easurement Systems Analysis (I Capa <u>b</u> ility Analysis	MSA)
Graphical Analysis	
<u>H</u> ypothesis Tests	8
Regression	Graphical Analysis
DOE	Use to examine the distribution of data, track data over time, and
Before/After Capability Analysis.	evaluate relationships between
Before/After Control Charts	variables.

The Assistant presents three objectives to choose from.



Graph the distribution of data	Graph variables over time ↓	Graph relationships between variables		
Help Me Choose	Help Me Choose	Help Me Choose		
DISPLAY A GRAPH	DISPLAY A GRAPH	DISPLAY A GRAPH		
Graphical Summary	Time Series Plot	Scatterplot		
Histogram	I Chart	Scatterplot (groups)		
Boxplot	I-MR Chart	Contraction Screener		
Individual Value Plot	Xbar-R Chart	Scatterplot Screener (groups)		
Pareto Chart	P Chart	Main Effects Plot		
Bar Chart	U Chart	Main Effects Screener		
Pie Chart		Interaction Plot		
		Close		

You're investigating how closely the forecasts match the real high temperature. These data were recorded in the order they occurred, so graphing the variables over time could be useful. Select "Time Series Plot."

Since each type of forecast is in its own column, select "Y data are in more than one column." Then enter the columns for each of the three forecasts as well as the one that lists the actual temperature.

C1 Date C2 10 day C3 5 day	Process data How are your data arranged in the worksheet?	
C4 next day C5 high C6 10-diff	Y data are in more than one column <u>Y</u> columns:	•
C8 next-diff	10 day' '5 day' next day' high	A T
	Display © Start all at the same time © Plot in consecutive stages]
Select	OK	Cancel

Click OK and Minitab produces a Report Card that addresses assumptions for this analysis, a Diagnostic Report that helps identify patterns in the data, and the following Summary Report:



If the forecasts were consistent with the actual high temperatures, the four lines on the time series plot would stick close together as they run from left to right. They don't. Sometimes the points are close, but frequently they veer sharply away from one another. The blue line representing the 10-day forecasts often seems particularly distant from the purple line representing the actual high. The next-day forecast appears to follow the actual high temperature most closely.

Step 2: Test the Hypothesis

The time series plot suggests that the next day, 5-day and 10-day forecasts are not equally reliable. To compare the three forecasts and see if the data support this hypothesis, use **Assistant > Hypothesis**

Tests...

If you're not sure which test to use to analyze the data, let the Assistant guide you to the right choice.

Since these data represent three types of forecasts, you want to compare more than two samples.

Assistant – Hypothesis Tests		
Choose a Hypothesis	s Test	
· · · · · · · · · · · · · · · · · · ·	What is your objective?	?]
Compare one sample with a target	Compare two samples with each other	Compare more than two samples
Help Me Choose	Help Me Choose	Help Me Choose
PERFORM A TEST	PERFORM A TEST	PERFORM A TEST
µ⊥ 1-Samplet	μ ⊢⊶ 2-Sample t	µ ⊷ One-Way ANOVA
σ □ 1-Sample Standard Deviation	μ-μ ⊢⊷ Paired t	σ Standard Deviations Test
₽ 1-Sample % Defective	σ ⊷ 2-Sample Standard Deviation	₽ └──── └───── Chi-Square % Defective
Chi-Square Goodness-of-Fit	p →→→ 2-Sample % Defective	Chi-Square Test for Association
	Chi-Square Test for Association	
		Close

If you select "Help Me Choose", you can follow the decision tree to the right choice. Since this temperature data is continuous, and you need to compare more than two samples, the decision tree guides you to the One-Way ANOVA.



Fill out the dialog for One-Way ANOVA as shown, and click OK:

C1 Date	Sample data
C2 10 day C3 5 day	How are your data arranged in the worksheet?
24 next day 25 high 26 10-diff	Y data for each X value are in separate columns
	Y data columns:
C7 5-diff C8 next-diff	'10-diff '5-diff 'next-diff'
	· · · · · · · · · · · · · · · · · · ·
	Test setup
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	Test setup How much risk are you willing to accept of concluding there are differences withere are none? Alpha level: 0.05 • Power and sample size (optional) What difference between the means has practical value? Difference:

The Assistant's Summary Report clearly states that "Differences among the means are significant (p < 0.05)." The Mean Comparisons Chart shows that the 10-day forecast provides a significantly worse weather prediction than the next day forecast, while the 5-day and next-day forecasts appear to be equally accurate.



The Assistant also produces a Report Card, which checks your data against the assumptions of the analysis and alerts you to any potential issues, so you can be sure your results are reliable.

Check	Status	Description
Unusual Data	1	One data point (row 15) is unusual compared to the others in 5-diff. Because unusual data can have a strong influence on the results, you should try to identify the cause of its unusual nature. Correct any data entry or measurement errors. Consider removing data that are associated with special causes and repeating the analysis.
Sample Size	\checkmark	The sample is sufficient to detect differences among the means.
Normality	\checkmark	Because all your sample sizes are at least 15, normality is not an issue. The test is accurate with nonnormal data when the sample sizes are large enough.
Equal Variance	i	Minitab's Assistant uses Welch's method, which does not assume or require that the samples have equal variances. Research shows that the test performs well with unequal variances, even when the sample sizes are not equal.

The Report Card has flagged one data point as being unusual. However, a review of this data point shows that it is accurate, so it should remain in the analysis. The Report Card also confirms that the sample size is sufficiently large to detect differences and to satisfy assumptions of normality.

You've Weathered this Analysis!

Your analysis has demonstrated that if you're going to depend on weather reports to decide what to wear, the next-day forecast or even the 5-day forecast are the most reliable options.

Of course, weather is a highly variable, extremely complex process—and this data covers only 30 days in one location. Would the results be the same for 30 days of predictions for your part of the world? Now you know how to use the Assistant to find out!

What else could you discover by using the Assistant to analyze your data?

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