

# JMP 16 Updates in Time Series Platforms

Peng Liu, Principal Research Statistician Developer, JMP

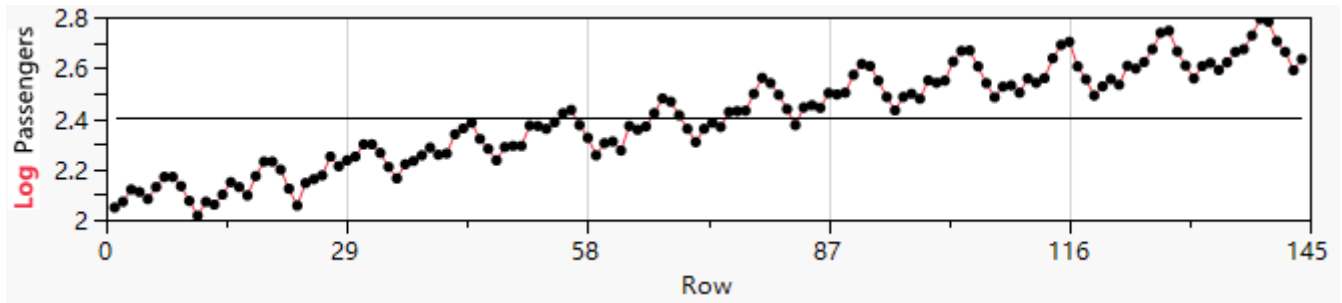
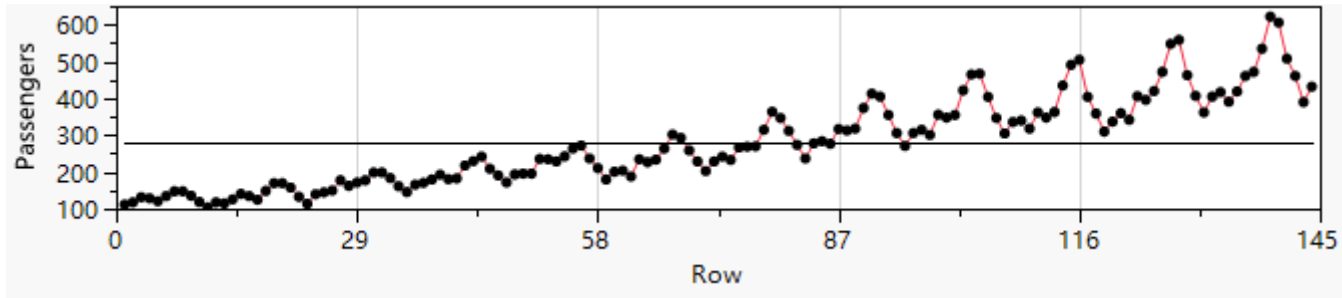
Jian Cao, Principal Systems Engineer, JMP

# Briefing

1. Analyze Box-Cox Transformed Time Series (Time Series)
2. Fit State Space Smoothing Models (Time Series)
3. Analyze Forecasting Performance Using Holdback (Time Series)
4. Select Models Using Holdback (Time Series Forecast)

# Analyze Box-Cox Transformed Time Series

- Time series need to be transformed so that variations remain constant as series changes. Example: Seriesg.jmp, variation increases as value increases.



# Analyze Box-Cox Transformed Time Series

- Time series need to be transformed so that variations remain constant as series changes. Example: Seriesg.jmp
- Before JMP 16, series needs to be manually transformed, followed by differencing if needed, fitting models, selecting model, making forecasts, and finally transforming forecasts back to the original scale.
- Starting from JMP 16, one can provide a Box-Cox transformation parameter value, the software will transform the series before modeling and inverse transform the forecasts to the original scale.
- The platform also provides “Box-Cox Transformation Plot” for identifying a desired transformation parameter value.

# Analyze Box-Cox Transformed Time Series

Select Columns

- 4 Columns
- Passengers
- Time
- Season
- Log Passengers

Autocorrelation Lags

Forecast Periods

Forecast on Holdback

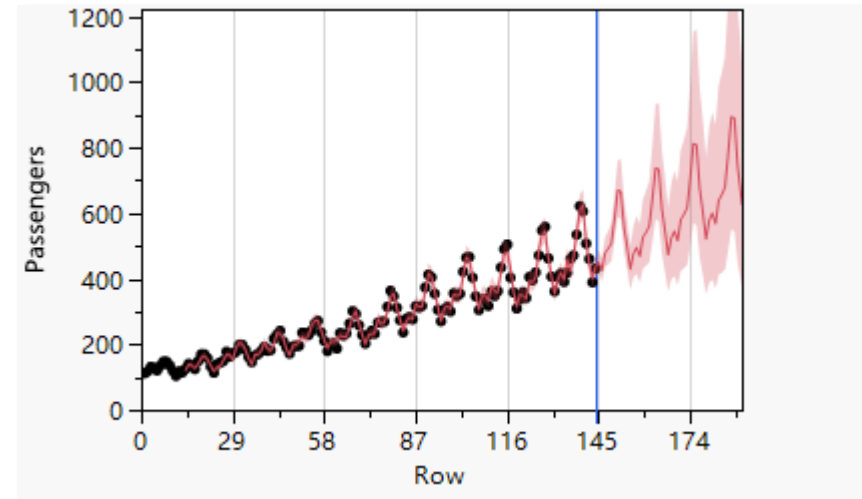
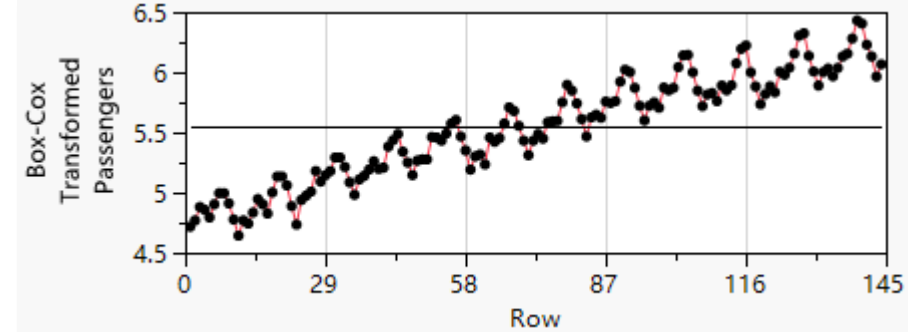
Use Box-Cox Transformation

Lambda for Box-Cox

Cast Selected Columns into Roles

Y, Time Series	Passengers <i>optional numeric</i>
Input List	<i>optional numeric</i>
X, Time ID	<i>optional numeric</i>
By	<i>optional</i>

Data must be sorted by time, evenly spaced.

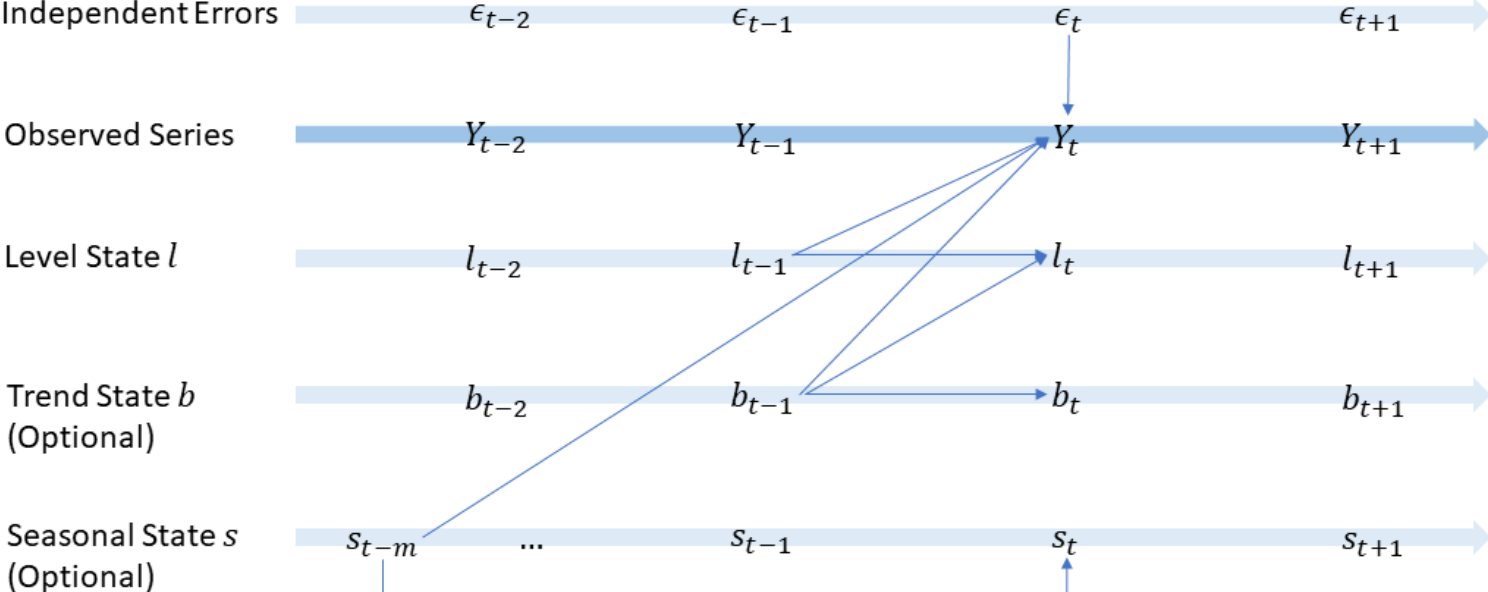


# State Space Smoothing Models

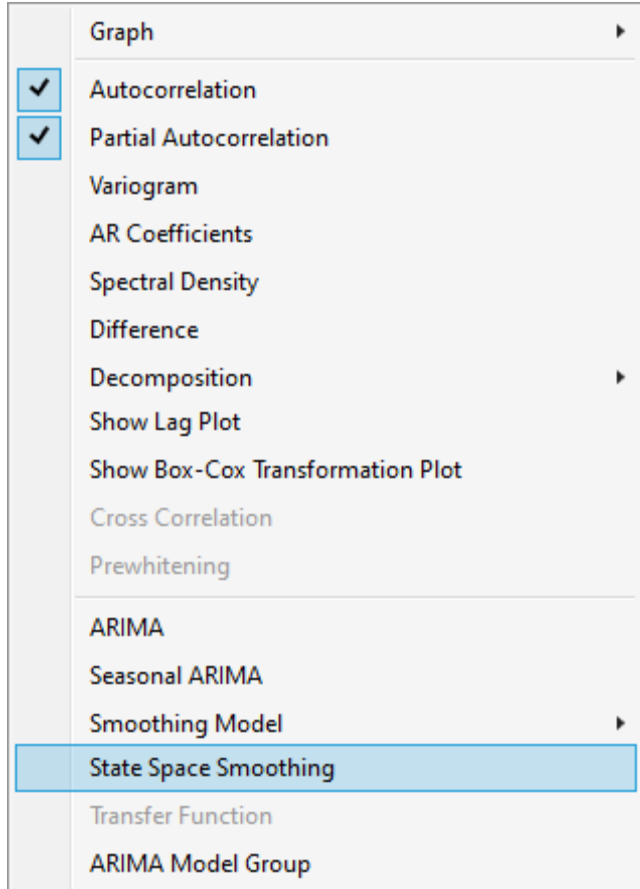
1. Workhorse in Time Series Forecast Platform (JMP15).
2. Fit and forecast a lot of series quickly.
3. Easy to specify - usually in two to three clicks.
4. Forecasting performance is comparable to ARIMA..
5. We were not able to study them individually in JMP 15.

# State Space Smoothing Models – Highly Distilled

$$Y_t = \left( \left( l_{t-1} \times b_{t-1} \right) \times s_{t-m} \right) \times (1 + \epsilon_t)$$



# State Space Smoothing Models in Time Series



- State Space Smoothing Models are added along the side of ARIMA models in Time Series platform in JMP 16.



# State Space Smoothing Models in Time Series

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Specify State Space Smoothing Models

State Space Smoothing Models

Additive Error Models

Trend	Seasonal		
	None	Additive	Multiplicative
None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Additive	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Additive with Damping	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Multiplicative	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Multiplicative with Damping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Select Recommended Select All Deselect All

Multiplicative Error Models

Trend	Seasonal		
	None	Additive	Multiplicative
None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Additive	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Additive with Damping	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Multiplicative	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Multiplicative with Damping	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Select Recommended Select All Deselect All

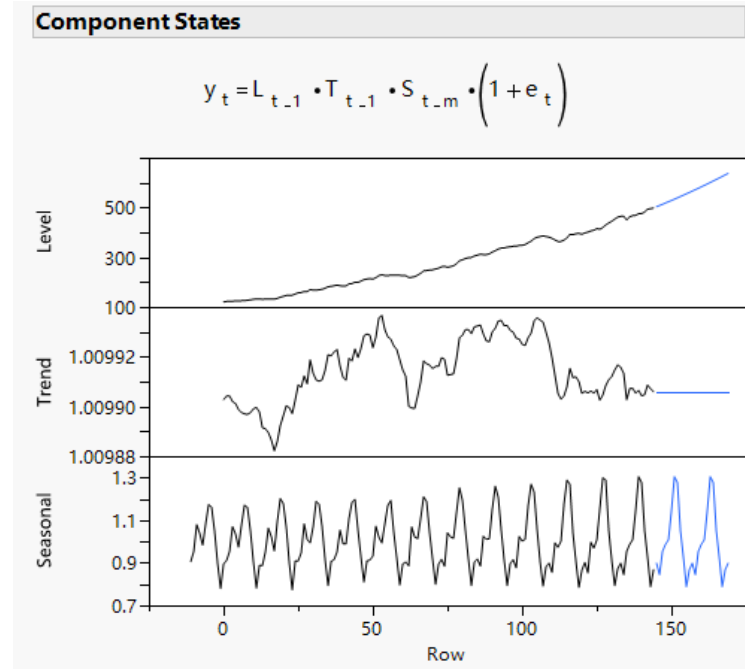
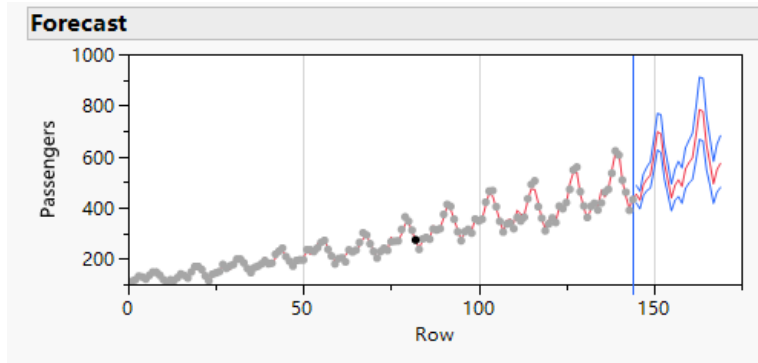
Period  Period > 0, Optional. Integer or comma delimited integers.

Constrain Parameters

OK Cancel

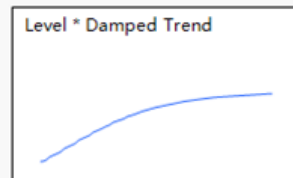
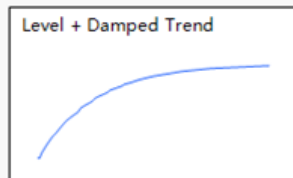
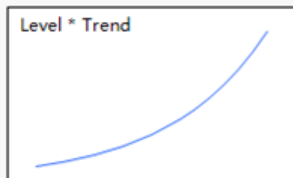
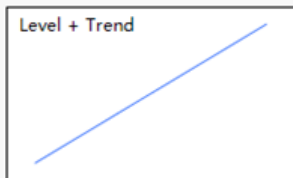
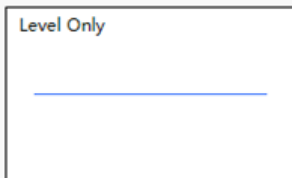
# State Space Smoothing Models in Time Series

- State Space Smoothing Models are added along the side of ARIMA models in Time Series platform in JMP 16.
- We can study them more carefully.

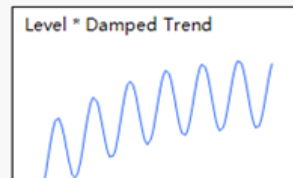
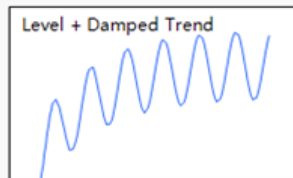
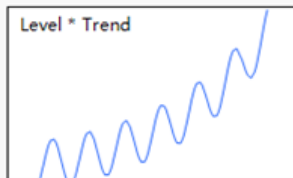
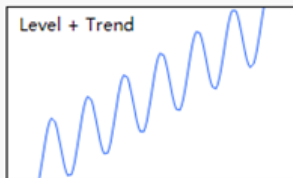
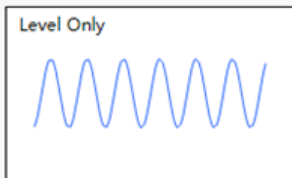


# Interpret Forecasts from Models

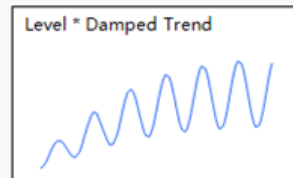
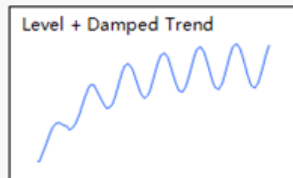
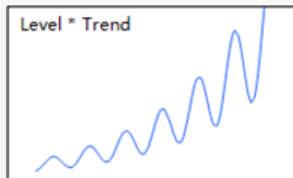
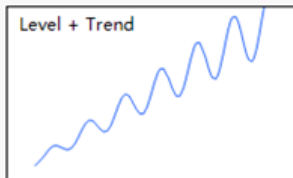
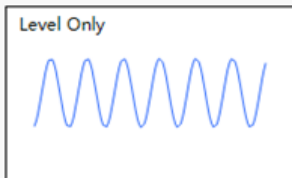
No  
Season



Additive  
Season



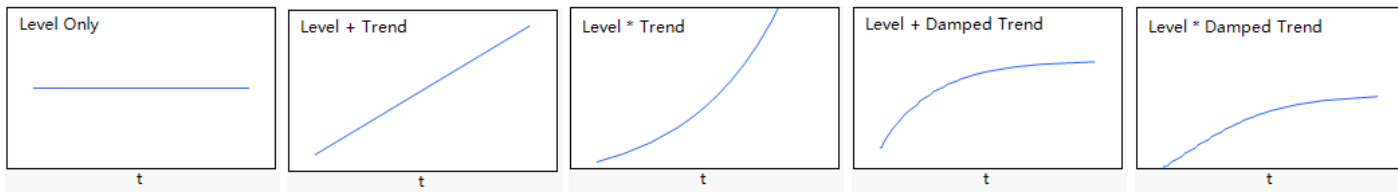
Multiplicative  
Season



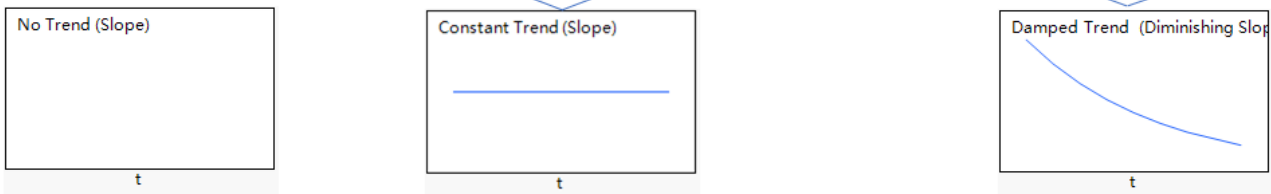
# Interpret Forecasts from Models

$$Y_t = \left( \left( l_{t-1} + b_{t-1} \right) \times s_{t-m} \right) \times (1 + \epsilon_t)$$

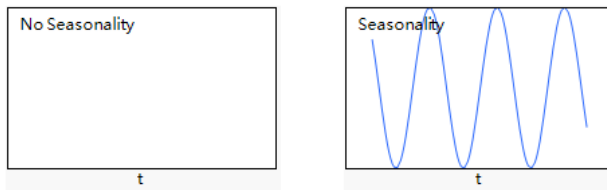
Level  $l$



Trend  $b$



Seasonal  $s$

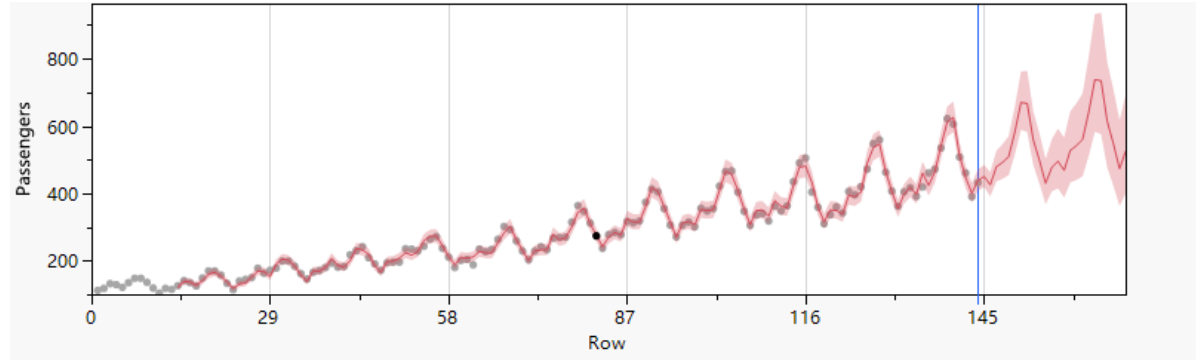


# What have we learned about them?

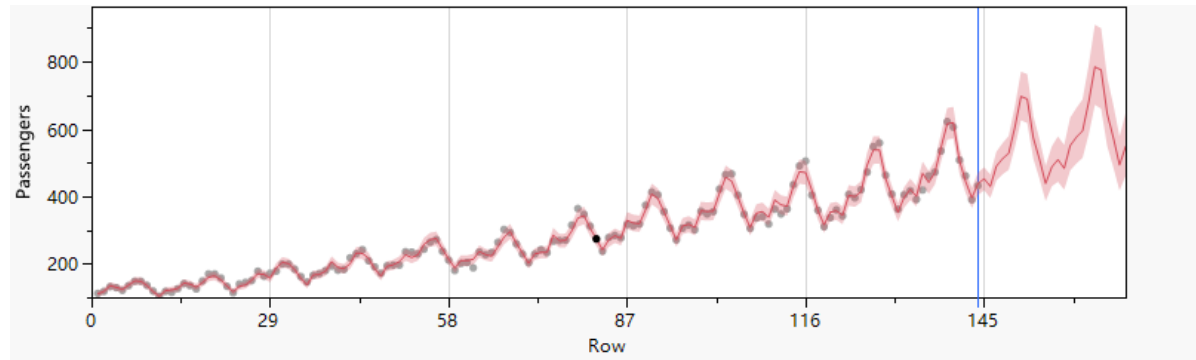
- Serious contenders to some ARIMA models.
- **NOT** stationary. None of them (30 MODELS)!
- Component-wised model and interpretation: Level, Trend, Seasonality. Give these models a try, if you see:
  - A linear or exponential growth trend
  - With or without seasonality
  - Non-stationary in general
- Be careful with stationary time series. (Try a simulated AR1.)
- AIC and other criteria are not comparable to those of ARIMA.

# Serious Contenders

- ARIMA(0,1,1)(0,1,1)12 No Intercept

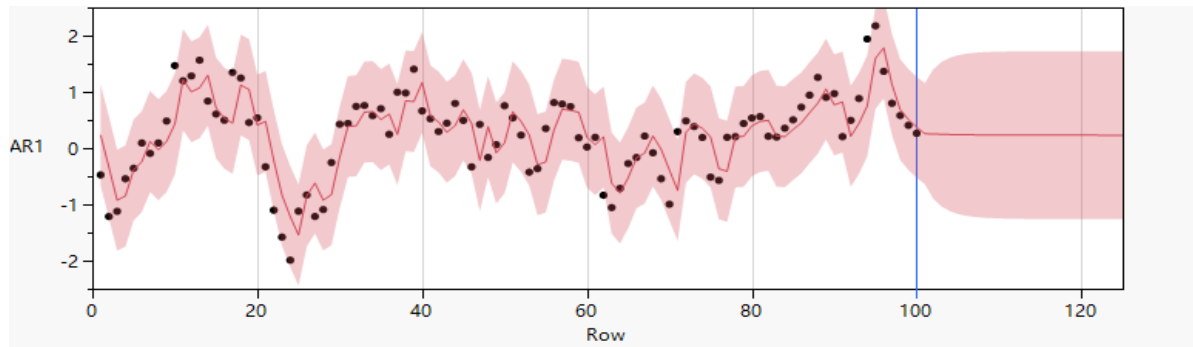


- MMM12 Constrained

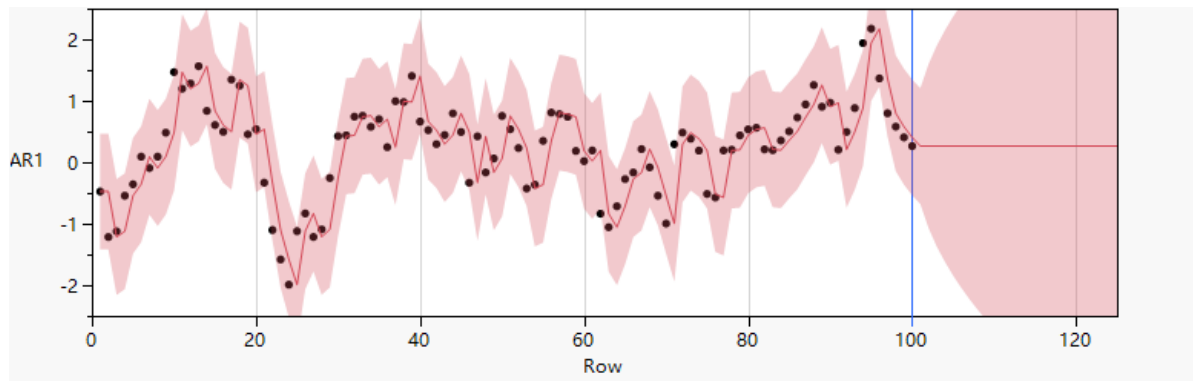


# Be Careful with Stationary Series

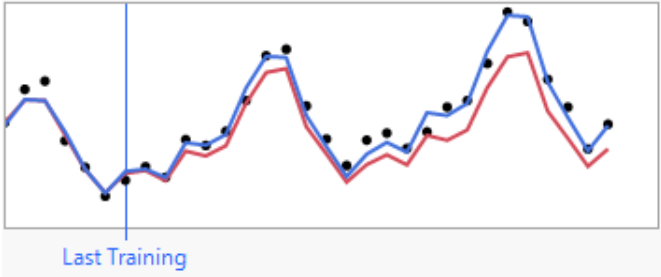
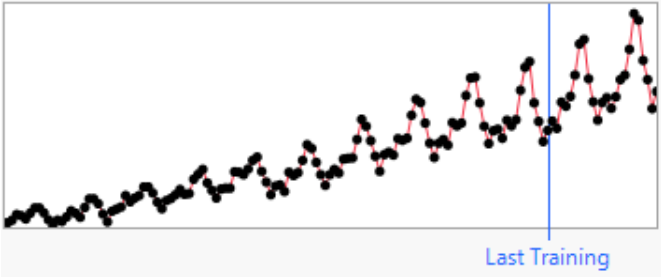
- AR(1)



- ANN12



# Forecast on Holdback in Time Series





# Forecast on Holdback in Time Series

## Definition and Setup

Select Columns

- 4 Columns
- Passengers
- Time
- Season
- Log Passengers

Autocorrelation Lags: 25

Forecast Periods: 24

Forecast on Holdback

Use Box-Cox Transformation

Cast Selected Columns into Roles

Y, Time Series	Passengers <i>optional numeric</i>
Input List	<i>optional numeric</i>
X, Time ID	<i>optional numeric</i>
By	<i>optional</i>

Action

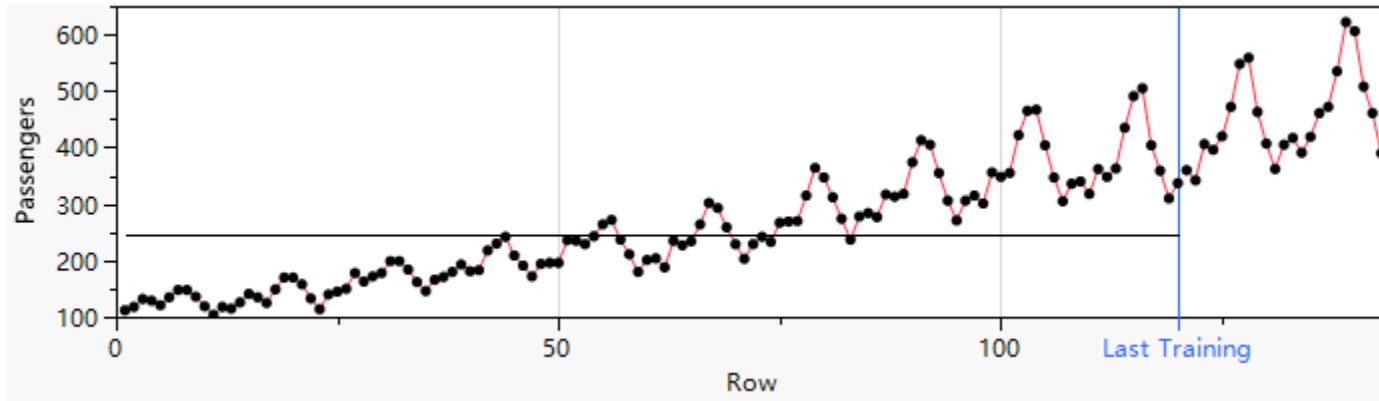
OK

Cancel

Remove

Recall

Help



# Forecast on Holdback in Time Series

## Model Comparison using Holdback

Model Comparison						
Report	Graph	Model	Holdback Evaluation			
			RMSE ^	MSE	MAPE	MAE
<input type="checkbox"/>	<input type="checkbox"/>	MMM12 Constrained	13.710324	187.97297	2.428228	10.796131
<input type="checkbox"/>	<input type="checkbox"/>	AAA12 Constrained	37.626487	1415.7525	7.091265	33.050751
<input type="checkbox"/>	<input type="checkbox"/>	MAA12 Constrained	44.147394	1948.9924	8.434577	39.175353
<input type="checkbox"/>	<input type="checkbox"/>	MAdA12 Constrained	52.518783	2758.2226	10.044976	46.515838
<input type="checkbox"/>	<input type="checkbox"/>	MAM12 Constrained	54.937136	3018.0889	10.011957	47.596804
<input type="checkbox"/>	<input type="checkbox"/>	AAdA12 Constrained	58.172039	3383.9861	10.857980	50.070617
<input type="checkbox"/>	<input type="checkbox"/>	MAdM12 Constrained	62.118775	3858.7422	11.352640	53.485414
<input type="checkbox"/>	<input type="checkbox"/>	ANA12 Constrained	69.011395	4762.5727	13.292534	61.457064
<input type="checkbox"/>	<input type="checkbox"/>	MNM12 Constrained	82.306686	6774.3905	15.659781	73.589230
<input type="checkbox"/>	<input type="checkbox"/>	MMdM12 Constrained	84.353128	7115.4502	15.720692	74.340471
<input type="checkbox"/>	<input type="checkbox"/>	MMN Constrained	84.810488	7192.8188	12.573460	62.401343
<input type="checkbox"/>	<input type="checkbox"/>	AAN Constrained	117.48380	13802.443	18.855019	93.657697
<input type="checkbox"/>	<input type="checkbox"/>	MAN Constrained	118.58666	14062.796	19.129286	94.911715
<input type="checkbox"/>	<input type="checkbox"/>	MNA12 Constrained	123.41372	15230.946	22.272453	106.86659
<input type="checkbox"/>	<input type="checkbox"/>	MMdN Constrained	129.19050	16690.184	21.675540	106.56881
<input type="checkbox"/>	<input type="checkbox"/>	MAdN Constrained	135.75546	18429.545	23.213358	113.58829
<input type="checkbox"/>	<input type="checkbox"/>	AAdN Constrained	135.95150	18482.811	23.258402	113.79428
<input type="checkbox"/>	<input type="checkbox"/>	ANN Constrained	137.33125	18859.873	23.578081	115.25270
<input type="checkbox"/>	<input type="checkbox"/>	MNN Constrained	137.33127	18859.878	23.578086	115.25273

# What have we learned from holdback?

1. Information criteria describe how well a model fits the training data.
2. Holdback criteria describe how well a model performs over the holdback data.
3. The criteria are not equivalent to forecasting performance in the future. But give some degree of assurance.
4. Evaluating forecasting performance is **NOT** a part of model fitting process.

# Holdback Based Selection in Time Series Forecast

## Select Models

### State Space Smoothing Models

#### Additive Error Models

Trend	Seasonal		
	None	Additive	Multiplicative
None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Additive	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Additive with Damping	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Multiplicative	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Multiplicative with Damping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Select Recommended Select All Deselect All

Constrain Parameters

#### Multiplicative Error Models

Trend	Seasonal		
	None	Additive	Multiplicative
None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Additive	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Additive with Damping	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Multiplicative	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Multiplicative with Damping	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Select Recommended Select All Deselect All

## Forecasting Settings

Name	Value	Description
NAhead	4	NAhead >= 0, Optional. Forecast n-ahead future observations.
Period	4	Period > 0, Optional. Integer or comma delimited integers.

## Model Selection Strategy

Forecasting Performance Metric RMSE NHoldback 4

Thank You!

[jmp.com](http://jmp.com)

