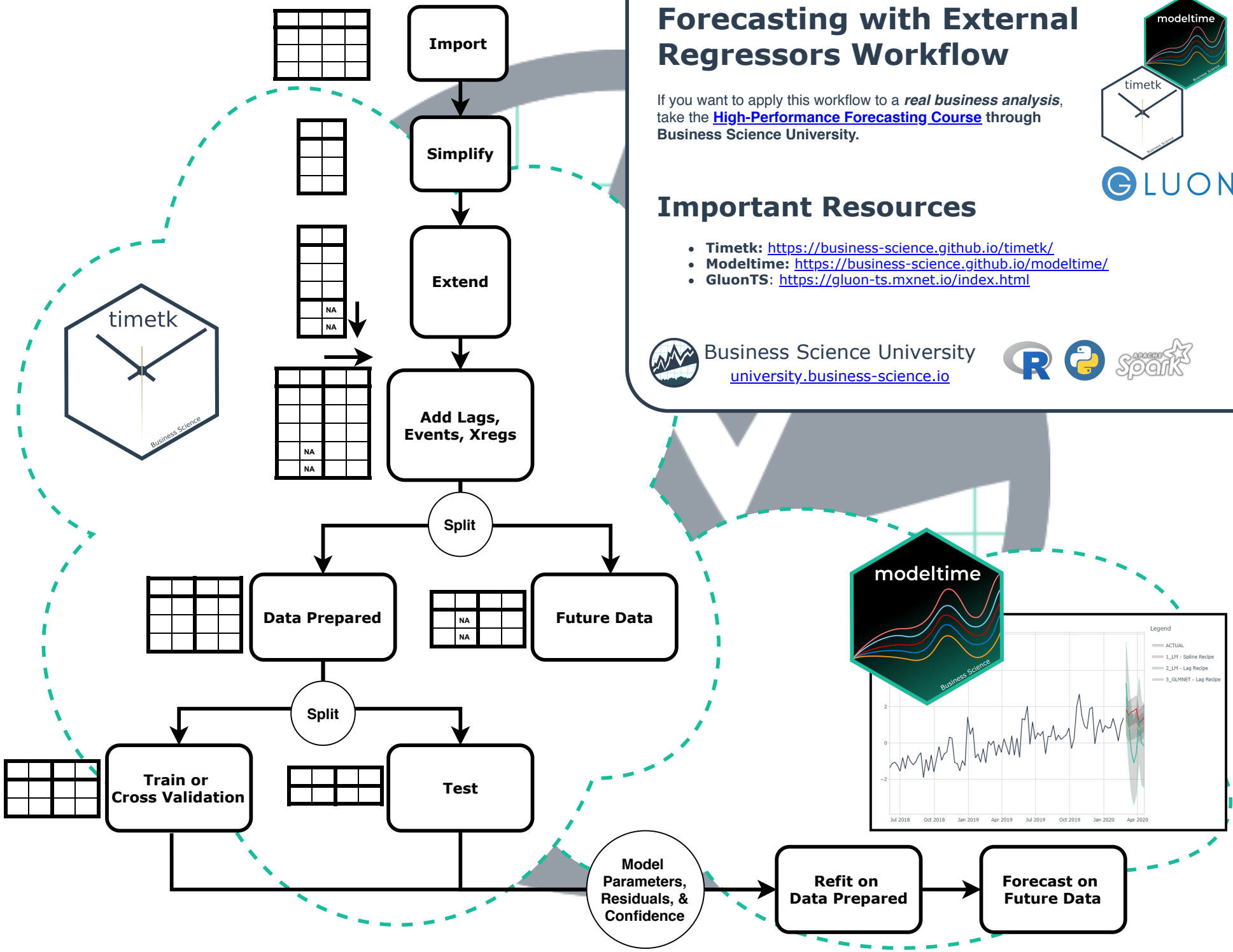
Forecasting with External Regressors Workflow

If you want to apply this workflow to a ***real business analysis***, take the **High-Performance Forecasting Course** through **Business Science University.**

Important Resources

- **Timetk:** https://business-science.github.io/timetk/
- **Modeltime:** https://business-science.github.io/modeltime/
- **GluonTS**: https://gluon-ts.mxnet.io/index.html

Business Science University
university.business-science.io



MODELTIME Workflow

Create Modeltime Table
`modeltime_table()`

```
# Modeltime Table
# A tibble: 5 x 3
  .model_id .model   .model_desc
      <int> <list>   <chr>
1         1 <fit[+]> ARIMA(0,1,1)(0,1,1)[12]
2         2 <fit[+]> ARIMA(0,1,1)(0,1,1)[12] W/ XGBOOST ERRORS
3         3 <fit[+]> ETS(M,A,A)
4         4 <fit[+]> LM
5         5 <fit[+]> EARTH
```

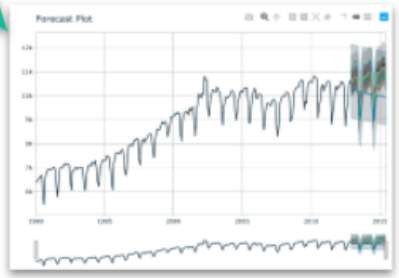
Calibrate
`modeltime_calibrate()`

```
# Modeltime Table
# A tibble: 6 x 5
  .model_id .model   .model_desc                          .type .calibration_data
      <int> <list>   <chr>                                <chr> <list>
1         1 <fit[+]> ARIMA(0,1,1)(0,1,1)[12]              Test  <tibble [31 × 4]>
2         2 <fit[+]> ARIMA(0,1,1)(0,1,1)[12] W/ XGBOOST ERRORS Test  <tibble [31 × 4]>
3         3 <fit[+]> ETS(M,A,A)                           Test  <tibble [31 × 4]>
4         4 <fit[+]> PROPHET                              Test  <tibble [31 × 4]>
5         5 <fit[+]> LM                                   Test  <tibble [31 × 4]>
6         6 <fit[+]> EARTH                                Test  <tibble [31 × 4]>
```

Refit
`modeltime_refit()`

```
# Modeltime Table
# A tibble: 6 x 5
  .model_id .model   .model_desc                          .type .calibration_data
      <int> <list>   <chr>                                <chr> <list>
1         1 <fit[+]> ARIMA(0,1,1)(0,1,1)[12]              Test  <tibble [31 × 4]>
2         2 <fit[+]> ARIMA(0,1,1)(0,1,1)[12] W/ XGBOOST ERRORS Test  <tibble [31 × 4]>
3         3 <fit[+]> ETS(A,A,A)                           Test  <tibble [31 × 4]>
4         4 <fit[+]> PROPHET                              Test  <tibble [31 × 4]>
5         5 <fit[+]> LM                                   Test  <tibble [31 × 4]>
6         6 <fit[+]> EARTH                                Test  <tibble [31 × 4]>
```

Forecast Test Set
`modeltime_forecast()`



`plot_modeltime_forecast()`

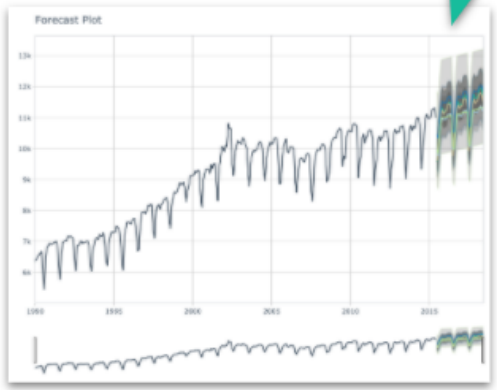
Test Accuracy
`modeltime_accuracy()`

Accuracy Table

.model_id	.model_desc	.type	mae	mape	mase	smape	rmse	rsq
1	ARIMA(0,1,1)(0,1,1)[12]	Test	151.33	1.41	0.52	1.43	197.71	0.93
2	ARIMA(0,1,1)(0,1,1)[12] W/ XGBOOST ERRORS	Test	147.04	1.37	0.50	1.39	191.84	0.93
3	ETS(M,A,A)	Test	77.00	0.73	0.26	0.73	90.27	0.98
4	PROPHET	Test	177.51	1.70	0.61	1.70	234.65	0.88
5	LM	Test	629.12	6.01	2.15	5.81	657.19	0.91
6	EARTH	Test	709.83	6.59	2.42	6.86	782.82	0.55

`table_modeltime_accuracy()`

Forecast Future
`modeltime_forecast()`



`plot_modeltime_forecast()`

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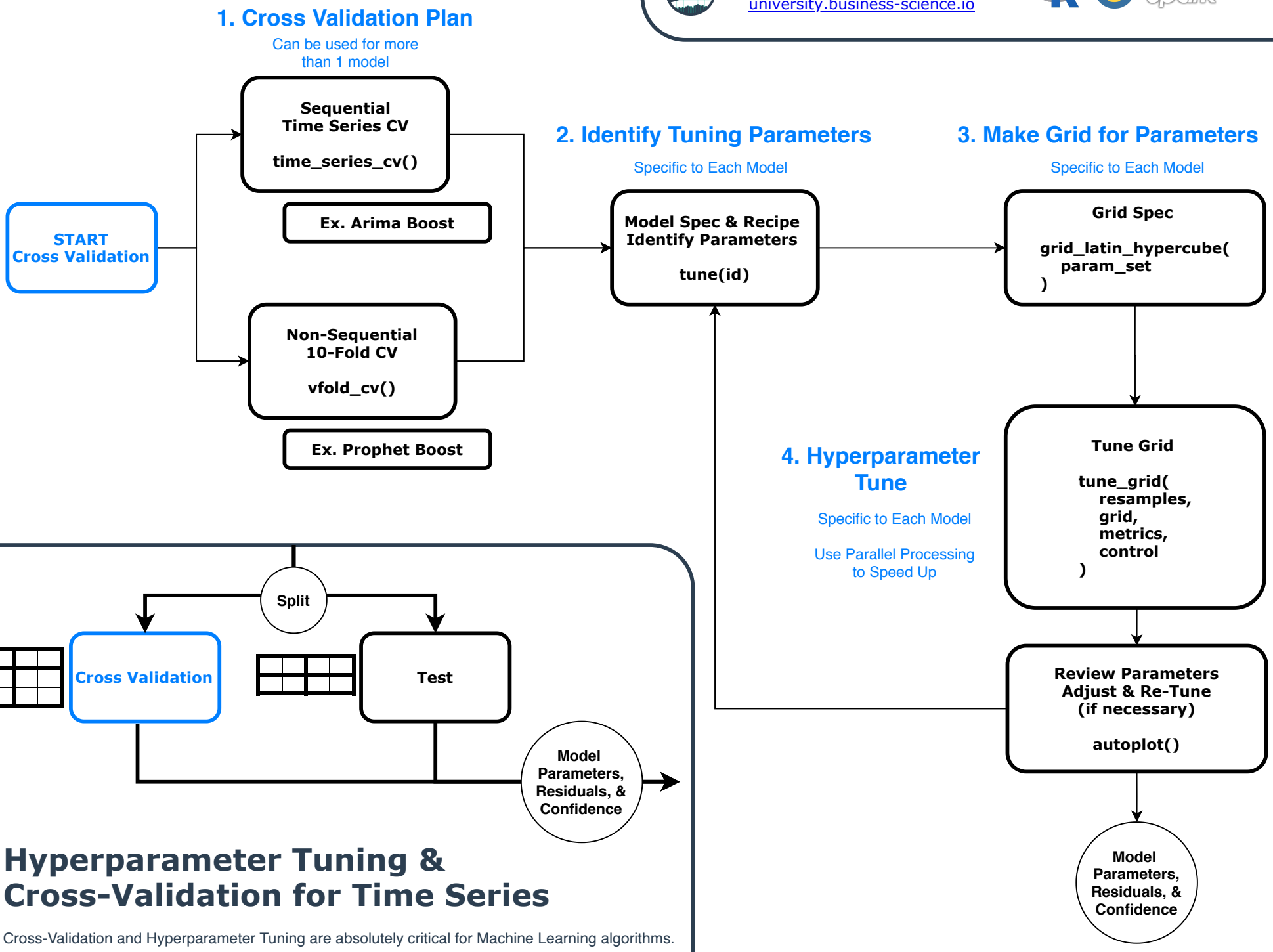

Hyperparameter Tuning & Cross-Validation for Time Series

Cross-Validation and Hyperparameter Tuning are absolutely critical for Machine Learning algorithms.

MODELTIME ENSEMBLE

Multi-Level Stacking

Level 3: Weighted Stack

`ensemble_weighted()`
`ensemble_average()`

Level 2:
Stacking Algorithms

`ensemble_model_spec()`
`modeltime_fit_resamples()`

Level 1:
Sub-Models