

Economic Scenario Tester

From Ultimate Risk Solutions

www.ultirisk.com

Economic Scenario Generator



- An **Economic Scenario Generator (ESG)** is a mathematical/statistical/econometric model
- Inputs
 - Historical values of Macroeconomic Variables
- Model
 - Assumptions about relationships between Macroeconomic Variables
- Outputs
 - Projections (simulations) of **Macroeconomic Variables**, such as:
 - ***Future inflation rates, GDP growth rates, currency exchange rates, interest rates, stock market indexes and many others***
 - Such projections are called “**economic scenarios**”
 - Produced by the thousands covering many projected periods

Uses of Economic Scenarios



- Economic Scenarios are used in financial projections
 - Asset/Liability Models (Life actuaries)
 - Dynamic Financial Analysis (Non-life actuaries)
 - Economic Capital models
 - Asset Portfolio models
- Market value of assets is impacted by fluctuations in interest rates, bond spreads and stock indexes
- Unpaid claims and other liabilities are impacted by inflation, interest rates
- Policyholder benefits in case of life models are affected by market values of assets used to back them
- In financial projections, **Economic Scenarios are the drivers of correlation between Assets and Liabilities**

Users of Economic Scenarios



- Actuaries (Life and Non-life)
- Financial analysts
- Capital modelers

- Econometricians **build** Economic Scenario Generators (ESGs), the others use the outputs

- **The users** of economic scenarios are not always experts in econometrics – yet the results of the models they build depend heavily on the quality of their ESGs

- **How do they verify that they are using good economic scenarios?**

Testing Criteria



- Economic scenarios should satisfy the following conditions:
 - ***Simulated*** values of any **INDIVIDUAL** macroeconomic variable exhibit similar behavior to the ***Historical*** behavior of the same variable
 - This means the future changes in the value of any macroeconomic variable capture the full range of its changes seen in the past
 - **ANY PAIR** of simulated variables behaves **COLLECTIVELY** as the corresponding pair of variables did in the past
 - This means that if, historically, variable X increases when variable Y decreases, then your economic scenarios should exhibit similar behavior

Burden of Model Validation



- Regulators and rating agencies are inspecting everyone's capital models ever more closely
- Companies that haven't historically built models are now being pressured to do so
- **Every set of assumptions must be validated**
- **Ultimate Risk Solutions** provides the **Economic Scenario Tester (EST)** to help companies **verify the credibility of the economic scenarios** they are using

URS Economic Scenario Tester (EST)



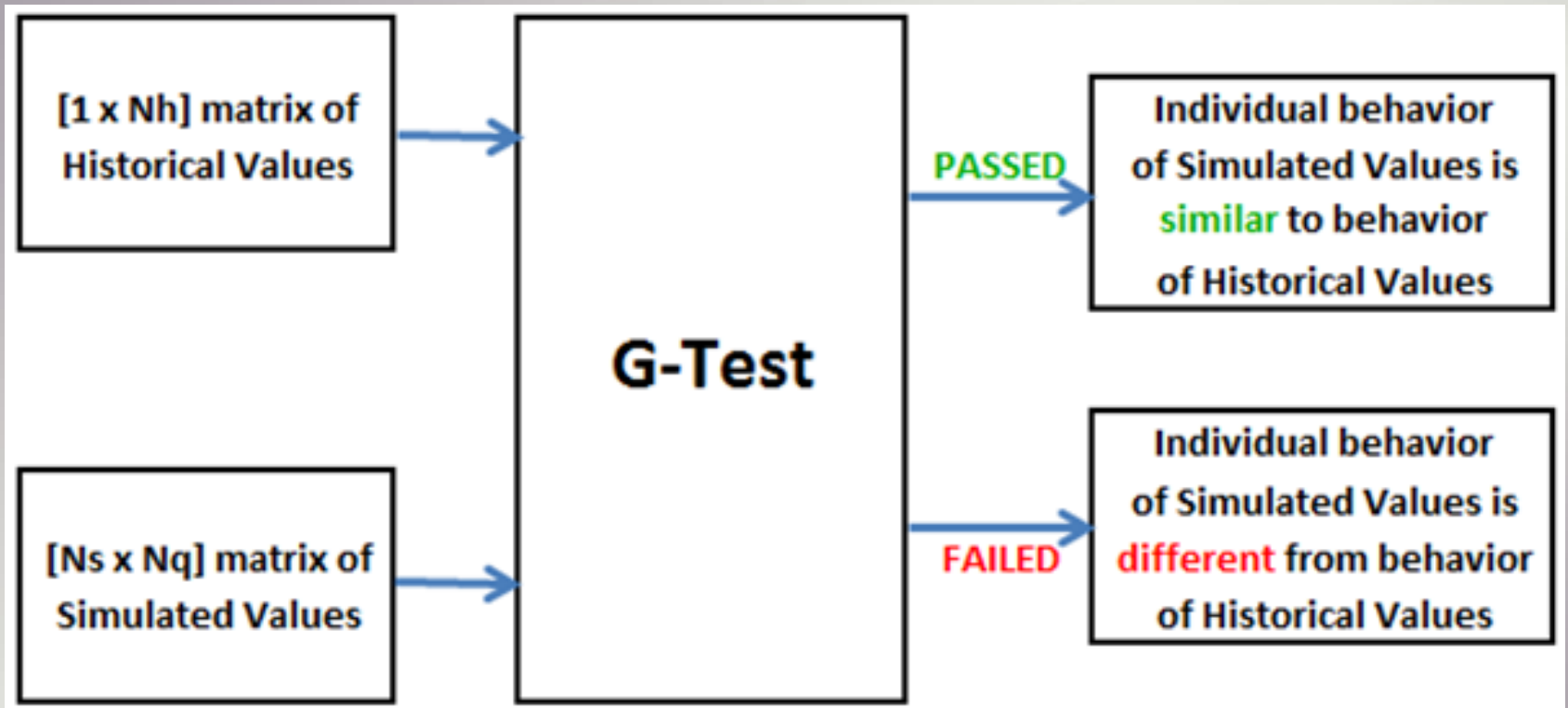
- Vendor-independent – scenarios from any provider can be tested the same way
- Fully documented methodology
- Open-source Excel/VBA that implement the above methodology
- Free of charge

The G-test

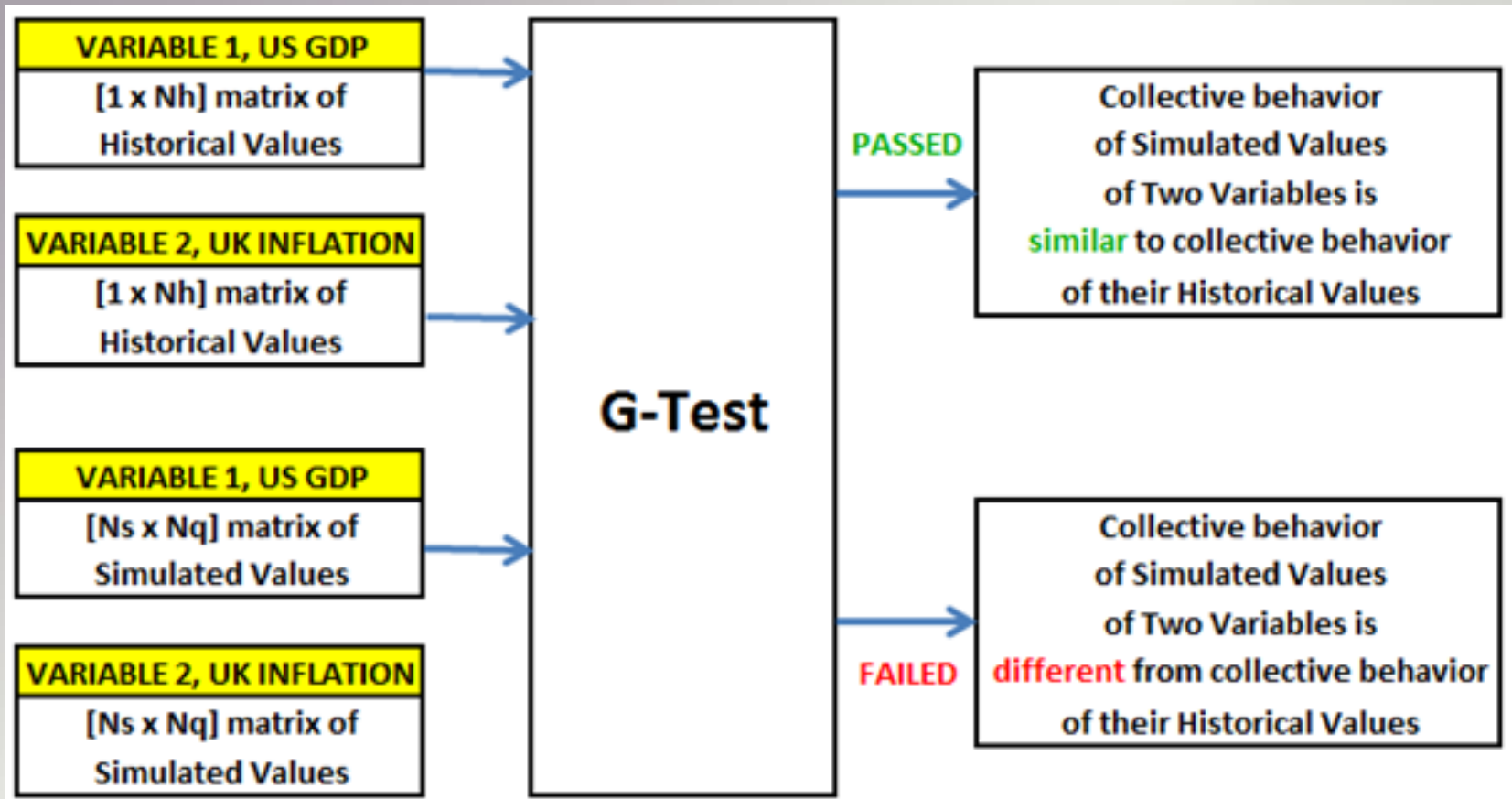


- G-test is a statistical hypothesis test
- In EST, it is used to test the hypothesis that Simulated economic data and Historical economic data come from the same underlying macroeconomic process
- Simulated data and Historical data are put into Bins
- Proportions of observations in each Bin are compared
- G-test produces G-test value which is compared to a percentile threshold to determine the goodness of fit

Testing an Individual Variable



Testing Pairs of Variables



Creating Bins for G-test



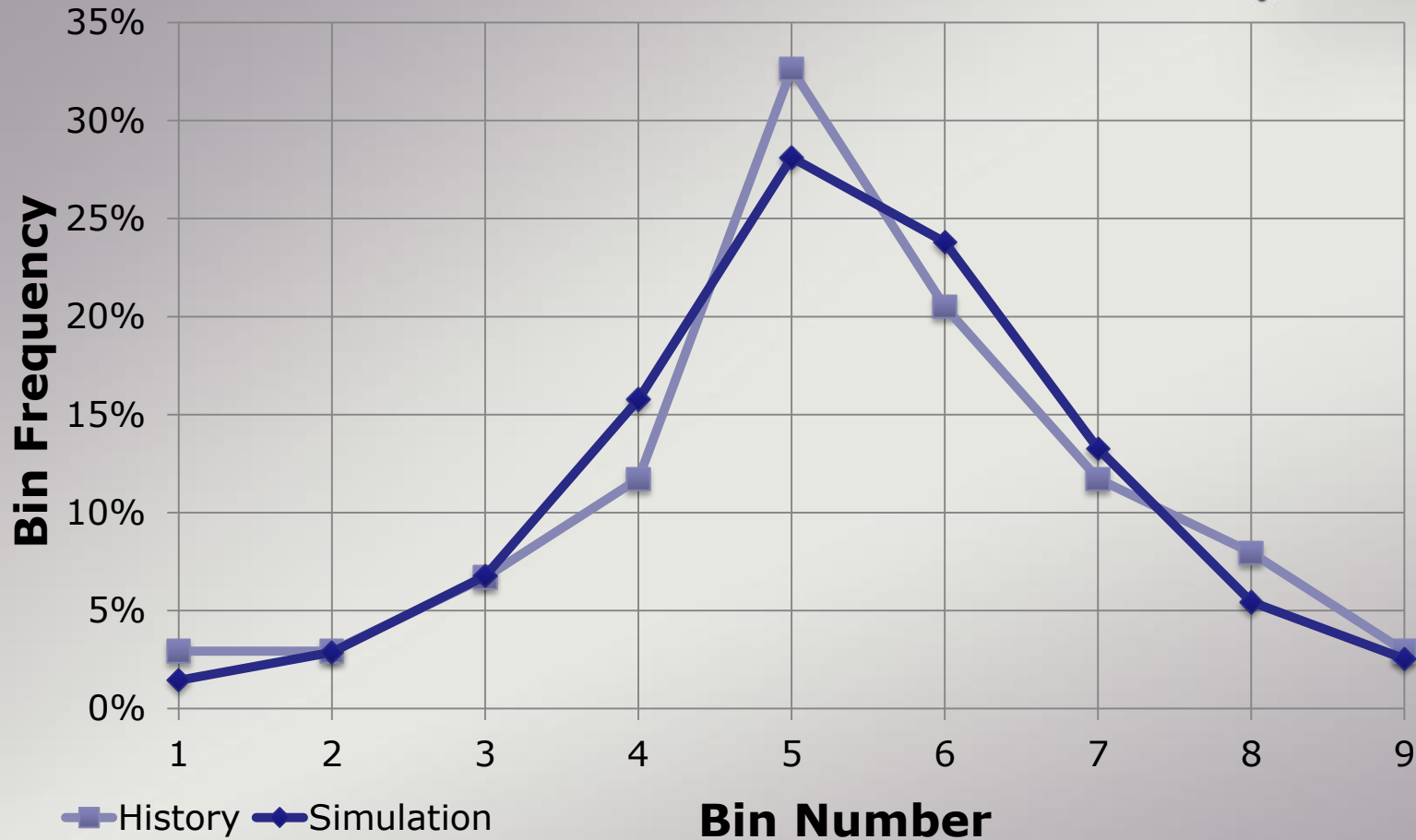
- A range of bins is created to count the observations falling into specified ranges
- A one-dimensional set of bins is created for a single variable test
- A two-dimensional set of bins is created when testing pairs of variables

Binning Individual Variable

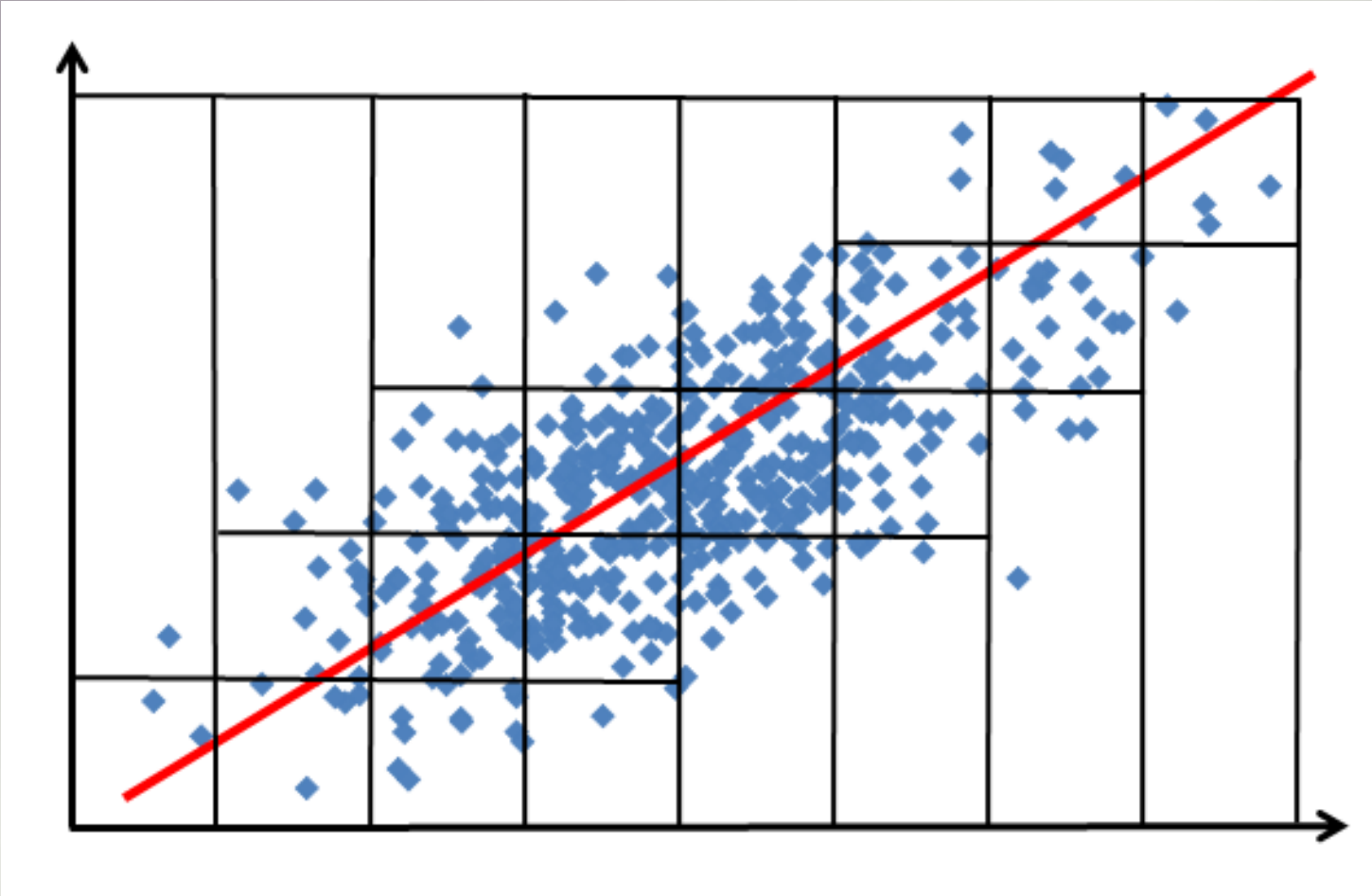


Bin #	GDP Growth Rate		Historical Data		Simulated Data	
	Lower	Upper	# values	Frequency	# values	Frequency
1	-0.0330	-0.0150	7	2.93%	338	1.44%
2	-0.0150	-0.0090	7	2.93%	674	2.87%
3	-0.0090	-0.0030	16	6.69%	1591	6.77%
4	-0.0030	0.0030	28	11.72%	3707	15.77%
5	0.0030	0.0090	78	32.64%	6607	28.11%
6	0.0090	0.0150	49	20.50%	5593	23.80%
7	0.0150	0.0210	28	11.72%	3116	13.26%
8	0.0210	0.0270	19	7.95%	1278	5.44%
9	0.0270	0.0450	7	2.93%	596	2.54%

Historical and Simulated Frequencies in Bins GDP Growth Rate



Two-Dimensional Bins

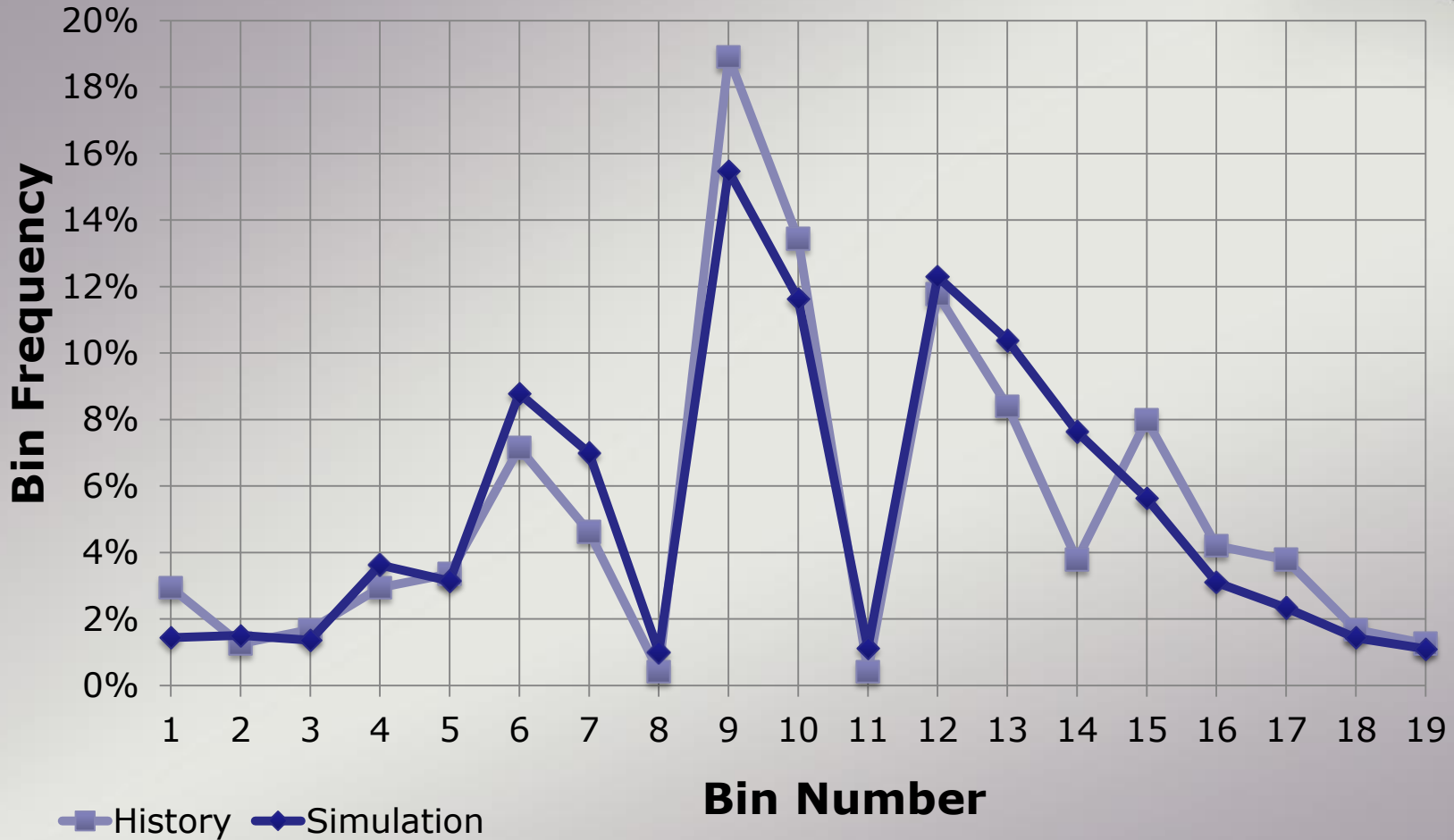


Binning Pairs of Variables

Bin #	US, GDP		UK, Unemployment Chg		Simulated Data		Historical Data	
	Lower	Upper	Lower	Upper	# values	Frequency	# values	Frequency
1	-0.033	-0.015	-0.014	0.014	338	1.44%	7	2.94%
2	-0.015	-0.009	-0.01	0.002	354	1.51%	3	1.26%
3	-0.015	-0.009	0.002	0.014	320	1.36%	4	1.68%
4	-0.009	-0.003	-0.01	0.002	852	3.63%	7	2.94%
5	-0.009	-0.003	0.002	0.014	739	3.14%	8	3.36%
6	-0.003	0.003	-0.01	0.002	2064	8.78%	17	7.14%
7	-0.003	0.003	0.002	0.014	1643	6.99%	11	4.62%
8	0.003	0.009	-0.014	-0.002	235	1.00%	1	0.42%
9	0.003	0.009	-0.002	0.002	3637	15.48%	45	18.91%
10	0.003	0.009	0.002	0.014	2735	11.64%	32	13.45%
11	0.009	0.015	-0.01	-0.002	264	1.12%	1	0.42%
12	0.009	0.015	-0.002	0.002	2889	12.29%	28	11.76%
13	0.009	0.015	0.002	0.014	2440	10.38%	20	8.40%
14	0.015	0.021	-0.01	0.002	1794	7.63%	9	3.78%
15	0.015	0.021	0.002	0.01	1322	5.63%	19	7.98%
16	0.021	0.027	-0.01	0.002	729	3.10%	10	4.20%
17	0.021	0.027	0.002	0.014	549	2.34%	9	3.78%
18	0.027	0.045	-0.01	0.002	337	1.43%	4	1.68%
19	0.027	0.045	0.002	0.014	259	1.10%	3	1.26%



Historical and Simulated Frequencies in Bins US, GDP Growth and UK, Unemployment



Excel-Based Model for Easy Validation of Methodology



	A	B	C	D	E	F	G	H	I	L	M	N
1												
2		Add Rows					Run Tests					
3												
4		Remove Rows										
5												
6												
7				Enter Economy ID or select Economy from combo-box			Enter Variable ID or select Variable from combo-box					
8												
9	#	Included		ID	Economy		ID	Variable		Result		
10	1	<input checked="" type="checkbox"/>		4	UK		1	Inflation		PASSED		CLICK TO SEE DETAILS
11	2	<input checked="" type="checkbox"/>		1	USA		2	Interest Rate, 3mo		PASSED		CLICK TO SEE DETAILS
12	3	<input checked="" type="checkbox"/>		1	EU		3	Inflation		PASSED		CLICK TO SEE DETAILS
13	4	<input checked="" type="checkbox"/>		1	UK		1	Interest Rate, 1yr		PASSED		CLICK TO SEE DETAILS
14	5	<input checked="" type="checkbox"/>		1	USA		2	S&P 500		PASSED		CLICK TO SEE DETAILS
15	6	<input checked="" type="checkbox"/>		1	China		3	Inflation		PASSED		CLICK TO SEE DETAILS
16	7	<input checked="" type="checkbox"/>		3	USA		4	Interest Rate, 10yr		PASSED		CLICK TO SEE DETAILS
17	8	<input checked="" type="checkbox"/>		1	EU		5	GDP		PASSED		CLICK TO SEE DETAILS
18	9	<input checked="" type="checkbox"/>		1	USA		6	Unemployment Rate		PASSED		CLICK TO SEE DETAILS
19	10	<input checked="" type="checkbox"/>		1	UK		7	GDP		PASSED		CLICK TO SEE DETAILS
20	11	<input checked="" type="checkbox"/>		2	USA		8	GDP		PASSED		CLICK TO SEE DETAILS