Black Swans & Bayesian Networks

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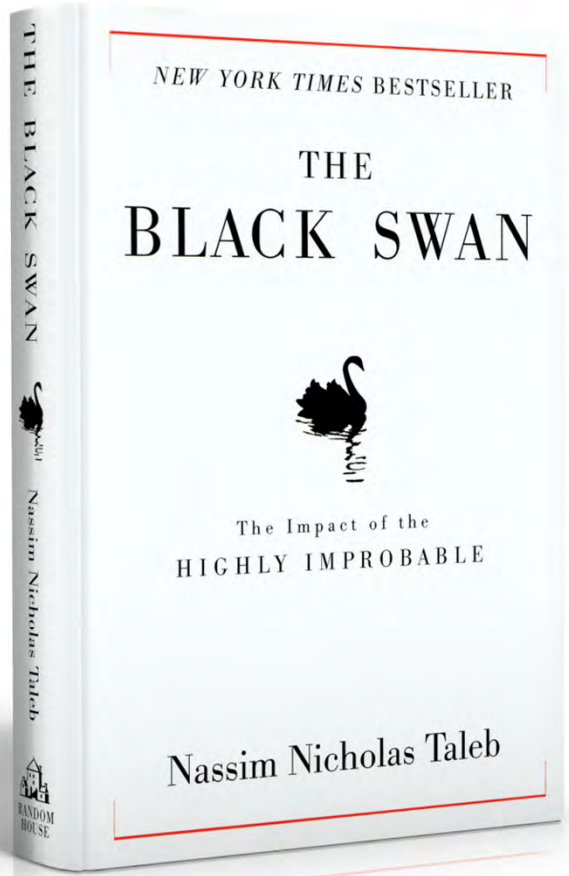
Webinar on July 19, 2019


NEW YORK TIMES BESTSELLER
THE
BLACK SWAN
The Impact of the
HIGHLY IMPROBABLE
Nassim Nicholas Taleb
THE BLACK SWAN
Nassim Nicholas Taleb
RANDOM HOUSE

“Black Swan”

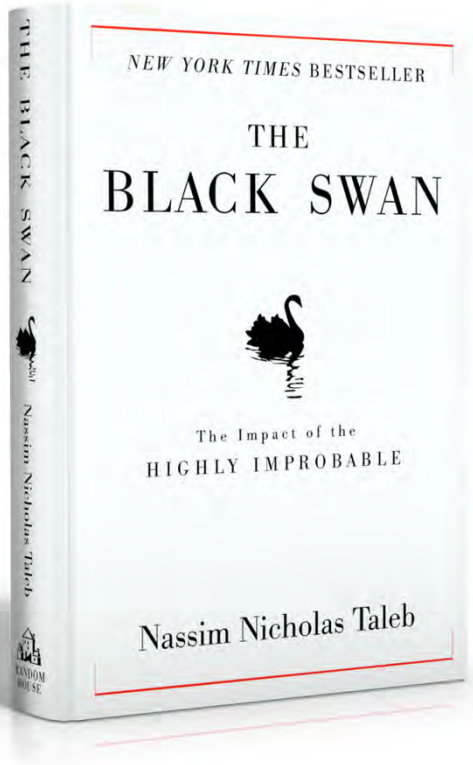
According to Taleb:

“What we call here a Black Swan (and capitalize it) is an event with the following three attributes.

First, it is an outlier, as it lies outside the realm of regular expectations, because nothing in the past can convincingly point to its possibility.

Second, it carries an extreme ‘impact’.

Third, in spite of its outlier status, human nature makes us concoct explanations for its occurrence after the fact, making it explainable and predictable.”



“Black Swan”

DECIMVS IVNIVS IVVENALIS
SATVRA VI

‘Nullane de tantis gregibus tibi digna videtur? ’
sit formosa decens dives fecunda, vetustos
porticibus disponat avos, intactior omni
crinibus effusis bellum dirimente Sabina, *rara avis in terris nigroque simillima cycno*: quis feret
uxorem cui constant omnia? malo, malo
Venusinam quam te, Cornelia, mater
Gracchorum, si cum magnis virtutibus adfers
grande supercilium et numeras in dote
triumphos, tolle tuum, precor, Hannibalem
victumque Syphacem in castris et cum tota
Carthagine migra.

“Do you say no worthy wife is to be found among all these crowds?” Well, let her be handsome, charming, rich and fertile; let her have ancient ancestors ranged about her halls; let her be more chaste than the disheveled Sabine maidens who stopped the war—*a prodigy as rare upon the earth as a black swan*! yet who could endure a wife that possessed all perfections? I would rather have a Venusian wench for my wife than you, O Cornelia, mother of the Gracchi, if, with all your virtues, you bring me a haughty brow, and reckon up Triumphs as part of your marriage portion. Away with your Hannibal, I beseech you! Away with Syphax overpowered in his camp! Take yourself off, Carthage and all!

Translated by G. G. Ramsay

Today's Agenda

General Research Question

- How to manage risks related to never-seen-before events?
- How to represent common and rare events jointly?

Specific Research Question

- How to find the optimal composition of a "pure-play" portfolio of maritime stocks, considering common and extreme events?

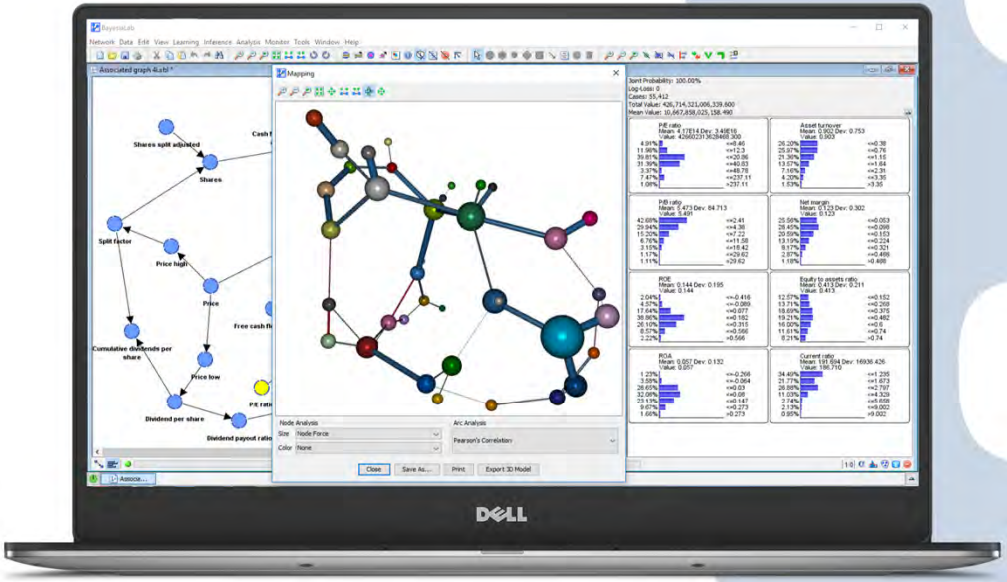
Today's Agenda (cont'd)

Analysis & Optimization Workflow with BayesiaLab

- Collect historical data from maritime shipping companies.
- Machine-learn Bayesian network to approximate the joint probability distribution of the underlying data.
- Select stocks and optimize portfolio given historical volatility.
- Hypothesize about potential risks and elicit assessments.

- Augment learned network with expert judgments.
- Optimize portfolio given common and hypothetical extreme events.

BAYESIALAB



A desktop software for:

- encoding
- learning
- editing
- performing inference
- analyzing
- simulating
- optimizing

with Bayesian networks.

BAYESIALAB

Desktop Software

Teaching Edition

Academic Edition

BayesiaLab Professional

Bayesia Market Simulator

Code Export Module

Web Application

BayesiaLab WebSimulator

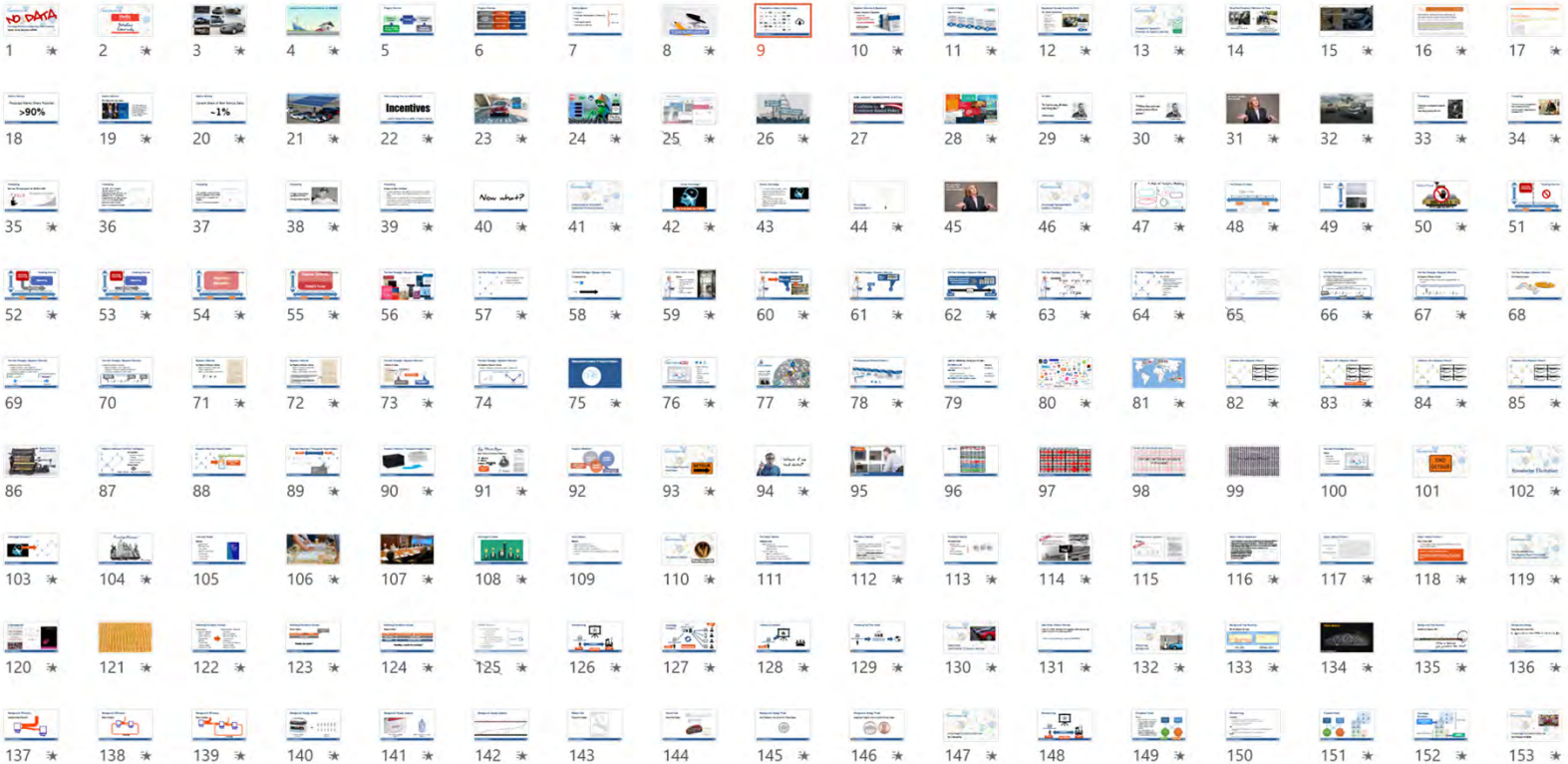
Bayesia Expert Knowledge Elicitation Environment (BEKEE)

API

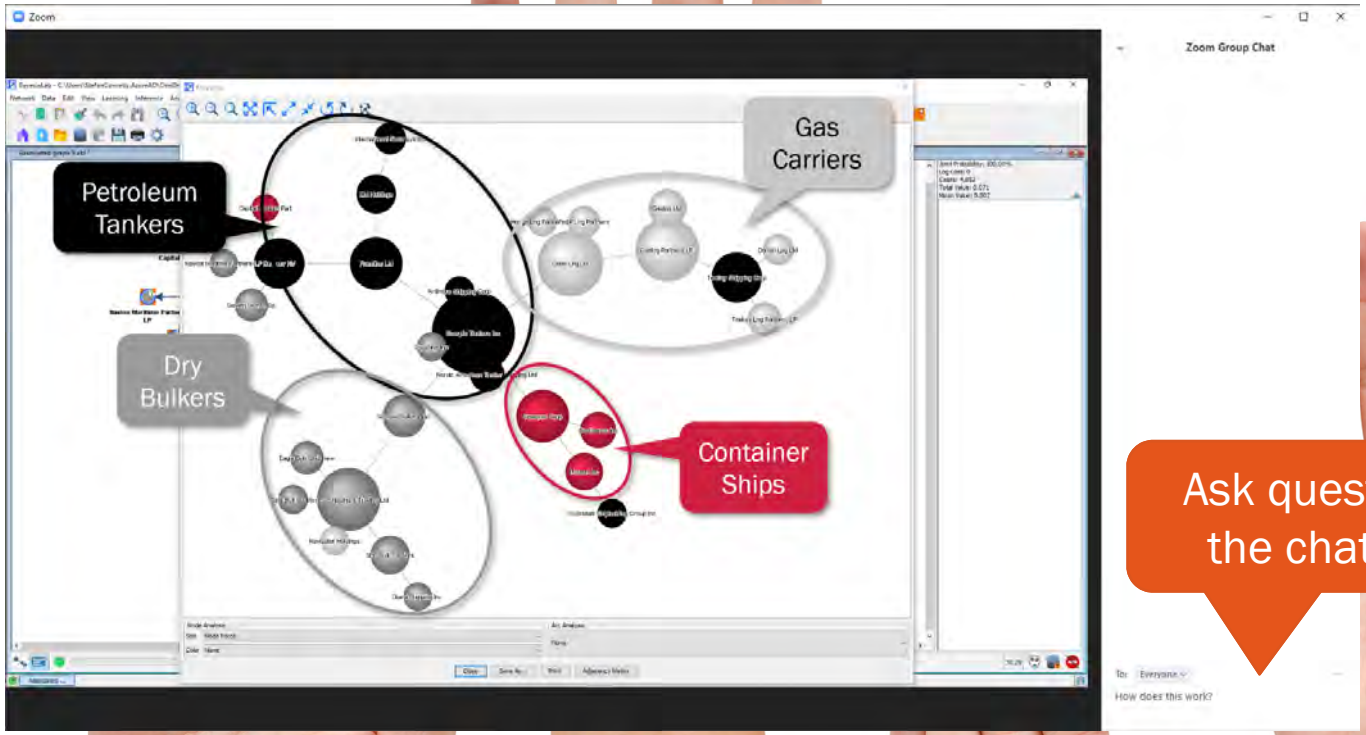
Bayesia Engine API for Modeling and Inference

Bayesia Engine API for Network Learning

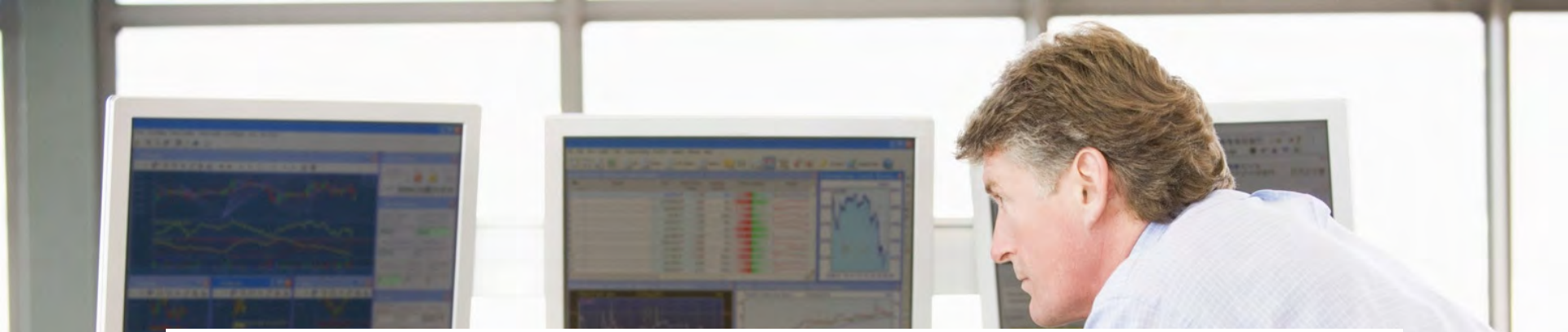
Slides, networks, and video will be available



Questions?


Zoom
Zoom Group Chat
Petroleum Tankers
Gas Carriers
Dry Bulkers
Container Ships
Ask questions via the chat panel.
How does this work?

Risk & Volatility



PORTFOLIO SELECTION*

HARRY MARKOWITZ
The Rand Corporation

THE PROCESS OF SELECTING a portfolio may be divided into two stages. The first stage starts with observation and experience and ends with beliefs about the future performances of available securities. The second stage starts with the relevant beliefs about future performances and ends with the choice of portfolio. This paper is concerned with the second stage. We first consider the rule that the investor does (or should) maximize discounted expected, or anticipated, returns. This rule is re-

This presumption, that the law of large numbers applies to a portfolio of securities, cannot be accepted. The returns from securities are too intercorrelated. Diversification cannot eliminate all variance.

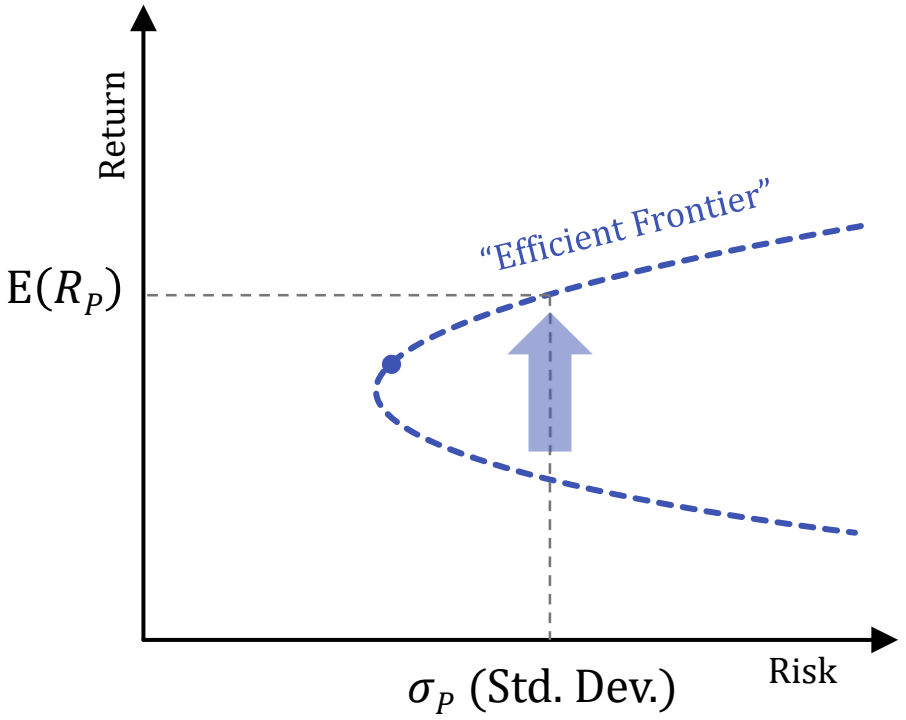
The portfolio with maximum expected return is not necessarily the one with minimum variance. There is a rate at which the investor can gain expected return by taking on variance, or reduce variance by giving up expected return.

We saw that the expected returns or anticipated returns rule is inadequate. Let us now consider the expected returns—variance of returns (E-V) rule. It will be necessary to first present a few elementary concepts and results of mathematical statistics. We will then show some implications of the E-V rule. After this we will discuss its plausi-

Modern Portfolio Theory

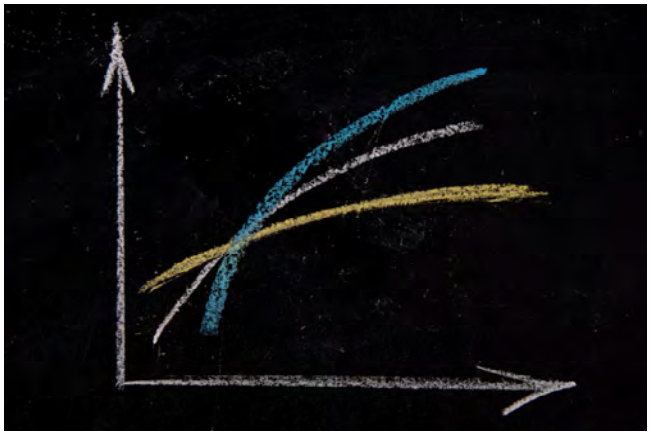
What is Modern Portfolio Theory?

- Modern Portfolio Theory (MPT) is a theory on how investors can construct portfolios to **maximize expected return based on a given level of market risk**.
- According to the theory, it's possible to construct an "efficient frontier" of optimal portfolios offering the maximum possible expected return for a given level of risk.

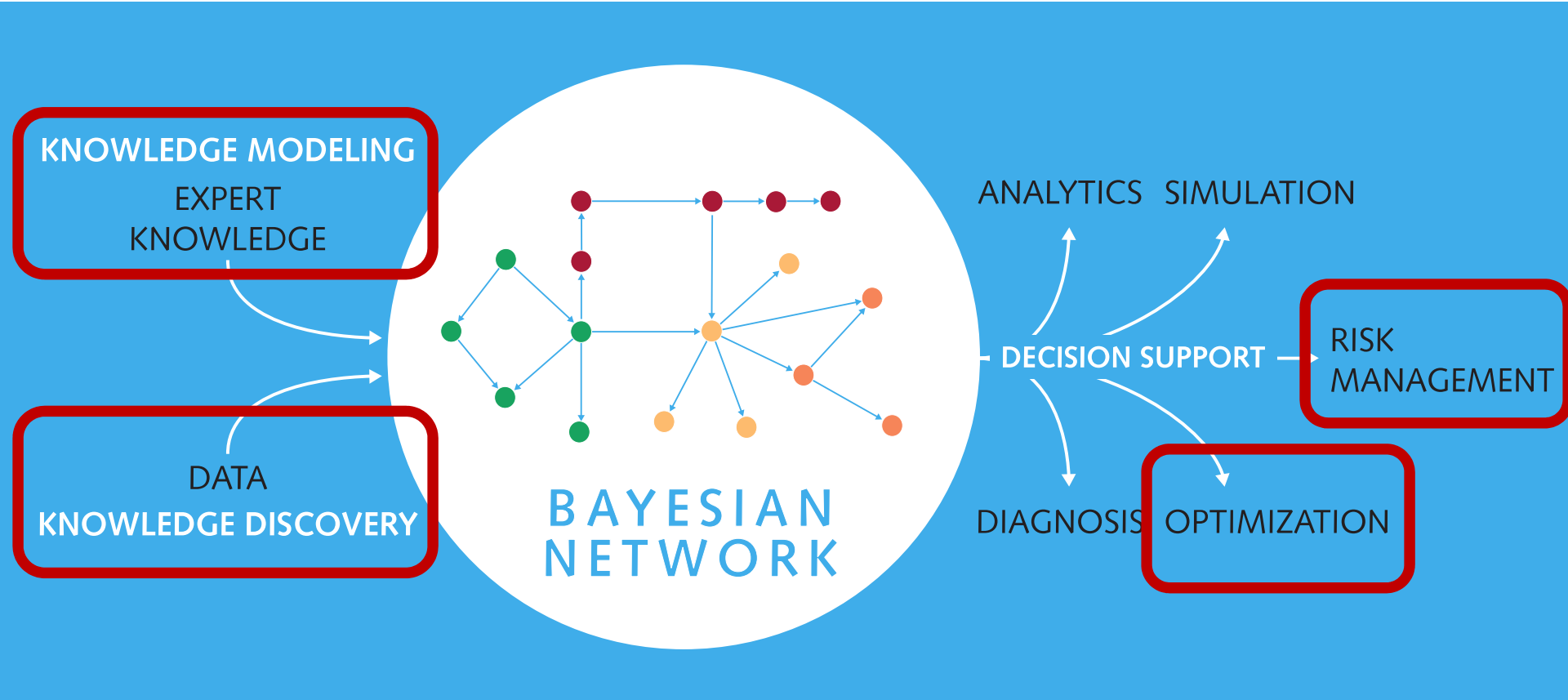


financial crisis
Crash of
isbelief, and a pu

Source of Models



Bayesian Networks



Case Study

“Pure-Play Maritime Portfolio”

Case Study Background

WTO Global Trade Forecast (2016–2030, Annualized)

- Worldwide: 5%
- China: 9%
- India: 9%
- ASEAN: 7%
- Sub-Saharan Africa: 7%
- ME & North Africa: 6%

Case Study

Industry Sectors Under Consideration

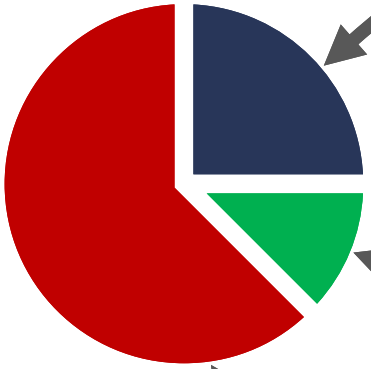
- Water Transportation & Deep-Sea Foreign Transportation of Freight

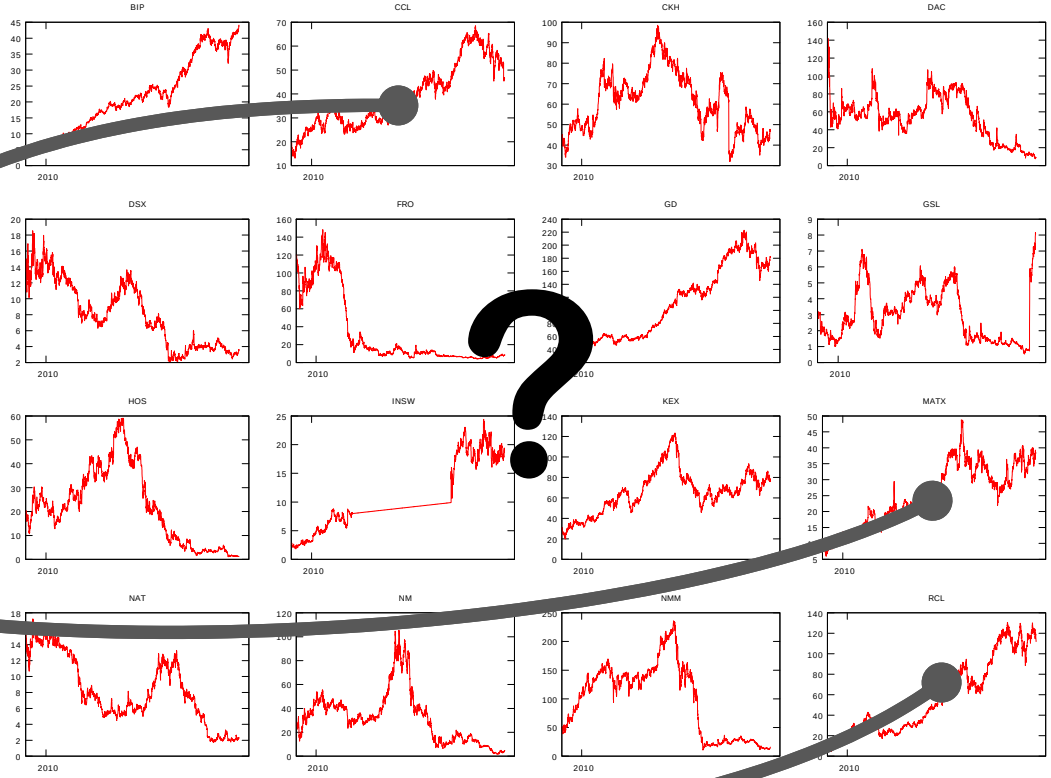
- Ardmore Shipping Corp
- Brookfield Infrastructure Partners LP
- Capital Product Part
- Carnival Corp
- Carnival Plc ADR
- Costamare Inc
- Dht Holdings
- Diana Containerships Inc
- Diana Shipping Inc
- Dorian Lpg Ltd
- Dryships Inc
- Dynagas Lng Partners LP
- Eagle Bulk Ship New
- Euronav NV
- Frontline Ltd
- Gaslog Ltd
- Gaslog Partners LP
- Genco Shipping & Trading Ltd
- Globus Maritime Limi
- Golar Lng Ltd
- Golar Lng Partners
- Golden Ocean Gp
- Grindrod Shipping Holdings Ltd
- Hoegh Lng Partners LP
- International Seaways Inc
- Kirby Corp
- Knot Offshore Partners LP
- Matson Inc
- Navigator Holdings
- Navios Maritime Acquisition Corp
- Navios Maritime Containers L.P.
- Navios Maritime Holdings Inc
- Navios Maritime Partners LP
- Nordic American Tanker Shipping Ltd
- Norwegian Cruise Ord
- Overseas Shipholding Group Inc
- Royal Caribbean Cruises Ltd
- Safe Bulkers Inc
- Scorpio Bulkers Inc
- Scorpio Tankers Inc
- Seacor Smit Inc
- Seaspan Corp
- Ship Finance International
- Star Bulk Carriers
- Stealthgas Inc
- Teekay Lng Partners LP
- Teekay Offshore Partners LP
- Teekay Shipping Corp
- Teekay Tankers Ltd
- Tidewater Inc
- Tsakos Energy Navigation Ltd

Case Study

Examples of Maritime Companies Traded in the U.S.

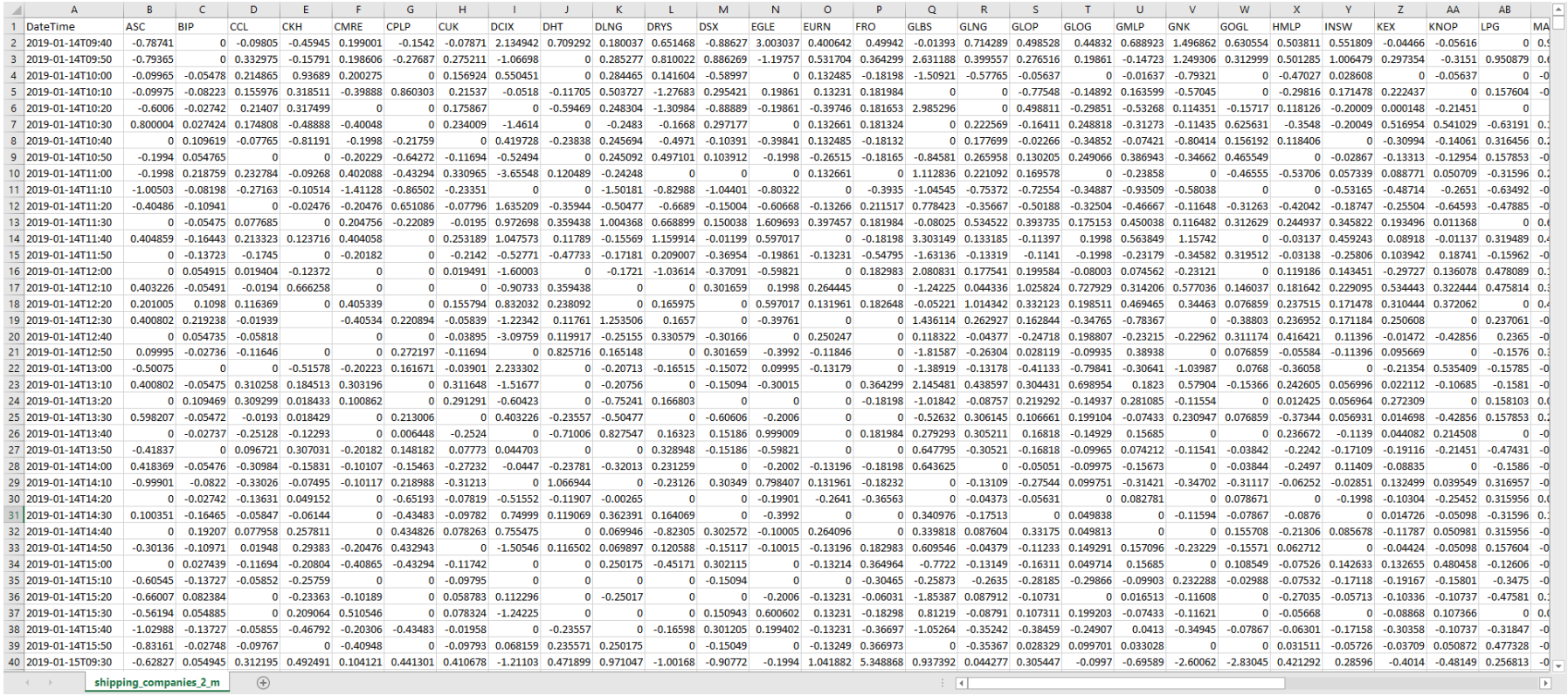
- Asset Allocation?





“Normal Conditions”

Historical Data



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	
1	DateTime	ASC	BIP	CCL	CKH	CMRE	CPLP	CUK	DCIX	DHT	DLNG	DRYS	DSX	EGLE	EURN	FRO	GLBS	GLNG	GLOP	GLOG	GMLP	GNK	GOGL	HMLP	INSW	KEX	KNOP	LPG	MA
2	2019-01-14T09:40	-0.78741	0	-0.09805	-0.45945	0.199001	-0.1542	-0.07871	2.134942	0.709292	0.180037	0.651468	-0.88627	3.003037	0.400642	0.49942	-0.01393	0.714289	0.498528	0.44832	0.688923	1.496862	0.630554	0.503811	0.551809	-0.04466	-0.05616	0	0.9
3	2019-01-14T09:50	-0.79365	0	0.332975	-0.15791	0.198606	-0.27687	0.275211	-1.06698	0	0.285277	0.810022	0.886269	-1.19757	0.531704	0.364299	2.631188	0.399557	0.276516	0.19861	-0.14723	1.249306	0.312999	0.501285	1.006479	0.297354	-0.3151	0.950879	0.0
4	2019-01-14T10:00	-0.09965	-0.05478	0.214865	0.93689	0.200275	0	0.156924	0.550451	0	0.284465	0.141604	-0.58997	0	0.132485	-0.18198	-1.50921	-0.57765	-0.05637	0	-0.01637	-0.79321	0	-0.47027	0.028608	0	-0.05637	0	-0
5	2019-01-14T10:10	-0.09975	-0.08223	0.155976	0.318511	-0.39888	0.860303	0.21537	-0.0518	-0.11705	0.503727	-1.27683	0.295421	0.19861	0.13231	0.181984	0	0	-0.77548	-0.14892	0.163599	-0.57045	0	-0.29816	0.171478	0.222437	0	0.157604	-0
6	2019-01-14T10:20	-0.6006	-0.02742	0.21407	0.317499	0	0	0.175867	0	-0.59469	0.248304	-1.30984	-0.88889	-0.19861	-0.39746	0.181653	2.985296	0	0.498811	-0.29851	-0.53268	0.114351	-0.15717	0.118126	-0.20009	0.000148	-0.21451	0	
7	2019-01-14T10:30	0.800004	0.027424	0.174808	-0.48888	-0.40048	0	0.234009	-1.4614	0	-0.2483	-0.1668	0.297177	0	0.132661	0.181324	0	0.222569	-0.16411	0.248818	-0.31273	-0.11435	0.625631	-0.3548	-0.20049	0.516954	0.541029	-0.63191	0.1
8	2019-01-14T10:40	0	0.109619	-0.07765	-0.81191	-0.1998	-0.21759	0	0.419728	-0.23838	0.245694	-0.4971	-0.10391	-0.39841	0.132485	-0.18132	0	0.177699	-0.02266	-0.34852	-0.07421	-0.80414	0.156192	0.118406	0	-0.30994	-0.14061	0.316456	0.2
9	2019-01-14T10:50	-0.1994	0.054765	0	0	-0.20229	-0.64272	-0.11694	-0.52494	0	0.245092	0.497101	0.103912	-0.1998	-0.26515	-0.18165	-0.84581	0.265958	0.130205	0.249066	0.386943	-0.34662	0.465549	0	-0.02867	-0.13313	-0.12954	0.157853	-0
10	2019-01-14T11:00	-0.1998	0.218759	0.232784	-0.09268	0.402088	-0.43294	0.330965	-3.65548	0.120489	-0.24248	0	0	0	0.132661	0	1.112836	0.221092	0.169578	0	-0.23858	0	-0.46555	-0.53706	0.057339	0.088771	0.050709	-0.31596	0.2
11	2019-01-14T11:10	-1.00503	-0.08198	-0.27163	-0.10514	-1.41128	-0.86502	-0.23351	0	0	-1.50181	-0.82988	-1.04401	-0.80322	0	-0.3935	-1.04545	-0.75372	-0.72554	-0.34887	-0.93509	-0.58038	0	0	-0.53165	-0.48714	-0.2651	-0.63492	-0
12	2019-01-14T11:20	-0.40486	-0.10941	0	-0.02476	-0.20476	0.651086	-0.07796	1.635209	-0.35944	-0.50477	-0.6689	-0.15004	-0.60668	-0.13266	0.211517	0.778423	-0.35667	-0.50188	-0.32504	-0.46667	-0.11648	-0.31263	-0.42042	-0.18747	-0.25504	-0.64593	-0.47885	-0
13	2019-01-14T11:30	0	-0.05475	0.077685	0	0.204756	-0.22089	-0.0195	0.972698	0.359438	1.004368	0.668899	0.150038	1.609693	0.397457	0.181984	-0.08025	0.534522	0.393735	0.175153	0.450038	0.116482	0.312629	0.244937	0.345822	0.193496	0.011368	0	0.6
14	2019-01-14T11:40	0.404859	-0.16443	0.213323	0.123716	0.404058	0	0.253189	1.047573	0.11789	-0.15569	1.159914	-0.01199	0.597017	0	-0.18198	3.303149	0.133185	-0.11397	0.1998	0.563849	1.15742	0	-0.03137	0.459243	0.08918	-0.01137	0.319489	0.4
15	2019-01-14T11:50	0	-0.13723	-0.1745	0	-0.20182	0	-0.2142	-0.52771	-0.47733	-0.17181	0.209007	-0.36954	-0.19861	-0.13231	-0.54795	-1.63136	-0.13319	-0.1141	-0.1998	-0.23179	-0.34582	0.319512	-0.03138	-0.25806	0.103942	0.18741	-0.15962	-0
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18	2019-01-14T12:20	0.201005	0.1098	0.116369	0	0.405339	0	0.155794	0.832032	0.238092	0	0.165975	0	0.597017	0.131961	0.182648	-0.05221	1.014342	0.332123	0.198511	0.469465	0.34463	0.076859	0.237515	0.171478	0.310444	0.372062	0	0.4
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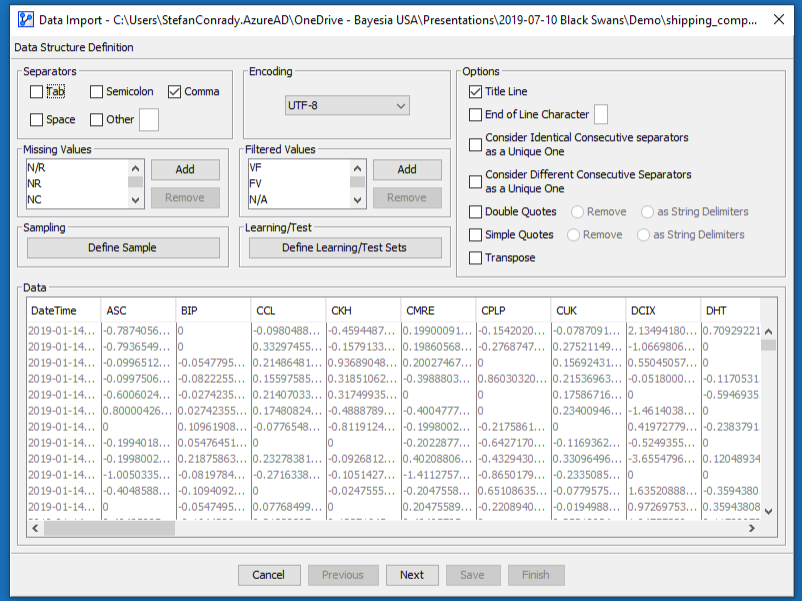
28	2019-01-14T14:00	0.418369	-0.05476	-0.30984	-0.15831	-0.10107	-0.15463	-0.27232	-0.0447	-0.23781	-0.32013	0.231259	0	-0.2002	-0.13196	-0.18198	0.643625	0	-0.05051	-0.09975	-0.15673	0	-0.03844	-0.2497	0.11409	-0.08835	0	-0.1586	-0
29	2019-01-14T14:10	-0.99901	-0.0822	-0.33026	-0.07495	-0.10117	0.218988	-0.31213	0	1.066944	0	-0.23126	0.30349	0.798407	0.131961	-0.18232	0	-0.13109	-0.27544	0.099751	-0.31421	-0.34702	-0.31117	-0.06252	-0.02851	0.132499	0.039549	0.316957	-0
30	2019-01-14T14:20	0	-0.02742	-0.13631	0.049152	0	-0.65193	-0.07819	-0.51552	-0.11907	-0.00265	0	0	-0.19901	-0.2641	-0.36563	0	-0.04373	-0.05631	0	0.082781	0	0.078671	0	-0.1998	-0.10304	-0.25452	0.315956	0.0
31	2019-01-14T14:30	0.100351	-0.16465	-0.05847	-0.06144	0	-0.43483	-0.09782	0.74999	0.119069	0.362391	0.164069	0	-0.3992	0	0	0.340976	-0.17513	0	0.049838	0	-0.11594	-0.07867	-0.0876	0	0.014726	-0.05098	-0.31596	0.1
32	2019-01-14T14:40	0	0.19207	0.077958	0.257811	0	0.434826	0.078263	0.755475	0	0.069946	-0.82305	0.302572	-0.10005	0.264096	0	0.339818	0.087604	0.33175	0.049813	0	0	0.155708	-0.21306	0.085678	-0.11787	0.050981	0.315956	-0
33	2019-01-14T14:50	-0.30136	-0.10971	0.01948	0.29383	-0.20476	0.432943	0	-1.50546	0.116502	0.069897	0.120588	-0.15117	-0.10015	-0.13196	0.182983	0.609546	-0.04379	-0.11233	0.149291	0.157096	-0.23229	-0.15571	0.062712	0	-0.04424	-0.05098	0.157604	-0
34	2019-01-14T15:00	0	0.027439	-0.11694	-0.20804	-0.40865	-0.43294	-0.11742	0	0	0.250175	-0.45171	0.302115	0	-0.13214	0.364964	-0.7722	-0.13149	-0.16311	0.049714	0.15685	0	0.108549	-0.07526	0.142633	0.132655	0.480458	-0.12606	-0
35	2019-01-14T15:10	-0.60545	-0.13727	-0.05852	-0.25759	0	0	-0.09795	0	0	0	0	-0.15094	0	0	-0.30465	-0.25873	-0.2635	-0.28185	-0.29866	-0.09903	0.232288	-0.02988	-0.07532	-0.17118	-0.19167	-0.15801	-0.3475	-0
36	2019-01-14T15:20	-0.66007	0.082384	0	-0.23363	-0.10189	0	0.058783	0.112296	0	-0.25017	0	0	-0.2006	-0.13231	-0.06031	-1.85387	0.087912	-0.10731	0	0.016513	-0.11608	0	-0.27035	-0.05713	-0.10336	-0.10737	-0.47581	0.1
37	2019-01-14T15:30	-0.56194	0.054885	0	0.209064	0.510546	0	0.078324	-1.24225	0	0	0	0.150943	0.600602	0.13231	-0.18298	0.81219	-0.08791	0.107311	0.199203	-0.07433	-0.11621	0	-0.05668	0	-0.08868	0.107366	0	0.0
38	2019-01-14T15:40	-1.02988	-0.13727	-0.05855	-0.46792	-0.20306	-0.43483	-0.01958	0	-0.23557	0	-0.16598	0.301205	0.199402	-0.13231	-0.36697	-1.05264	-0.35242	-0.38459	-0.24907	0.0413	-0.34945	-0.07867	-0.06301	-0.17158	-0.30358	-0.10737	-0.31847	-0
39	2019-01-14T15:50	-0.83161	-0.02748	-0.09767	0	-0.40948	0	-0.09793	0.068159	0.235571	0.250175	0	-0.15049	0	-0.13249	0.366973	0	-0.35367	0.028329	0.099701	0.033028	0	0	0.031511	-0.05726	-0.03709	0.050872	0.477328	-0
40	2019-01-15T09:30	-0.62827	0.054945	0.312195	0.492491	0.104121	0.441301	0.410678	-1.21103	0.471899	0.971047	-1.00168	-0.90772	-0.1994	1.041882	5.348868	0.937392	0.044277	0.305447	-0.0997	-0.69589	-2.60062	-2.83045	0.421292	0.28596	-0.4014	-0.48149	0.256813	-0

shipping_companies_2_m

BayesiaLab - No opened graph

Network Data Tools Window Help

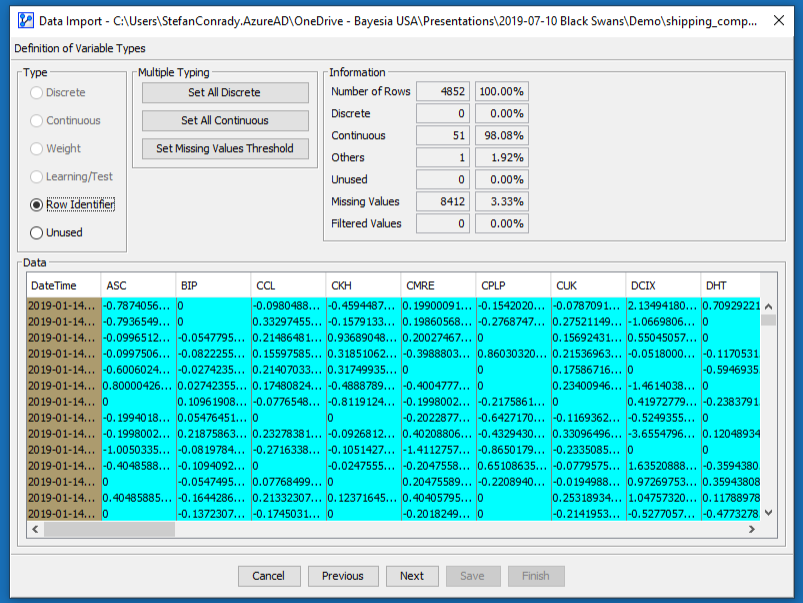
Data Import



BayesiaLab - No opened graph

Network Data Tools Window Help

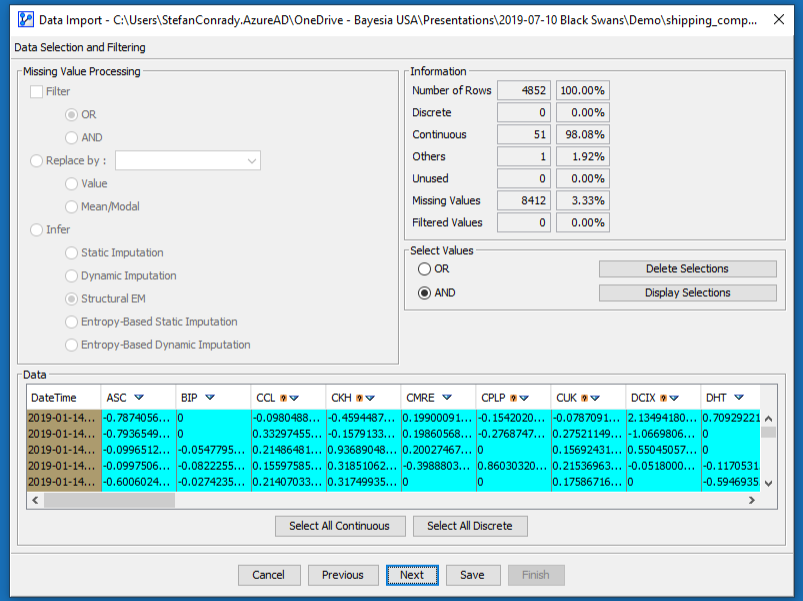
Variable Type Definition



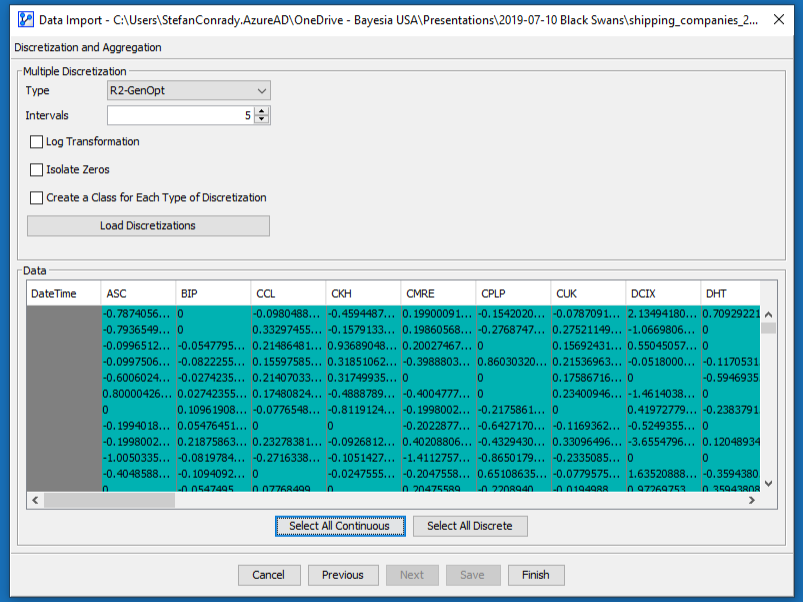
BayesiaLab - No opened graph

Network Data Tools Window Help

Missing Values Processing

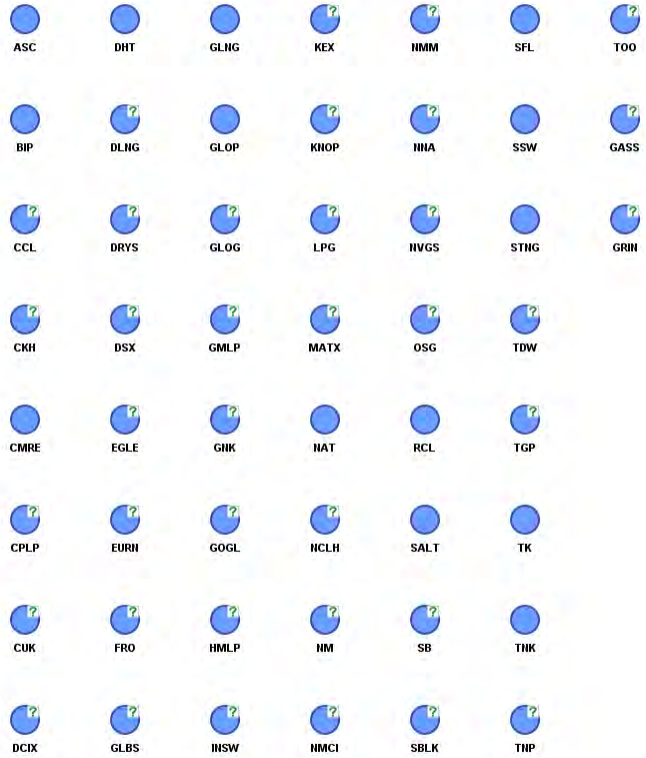


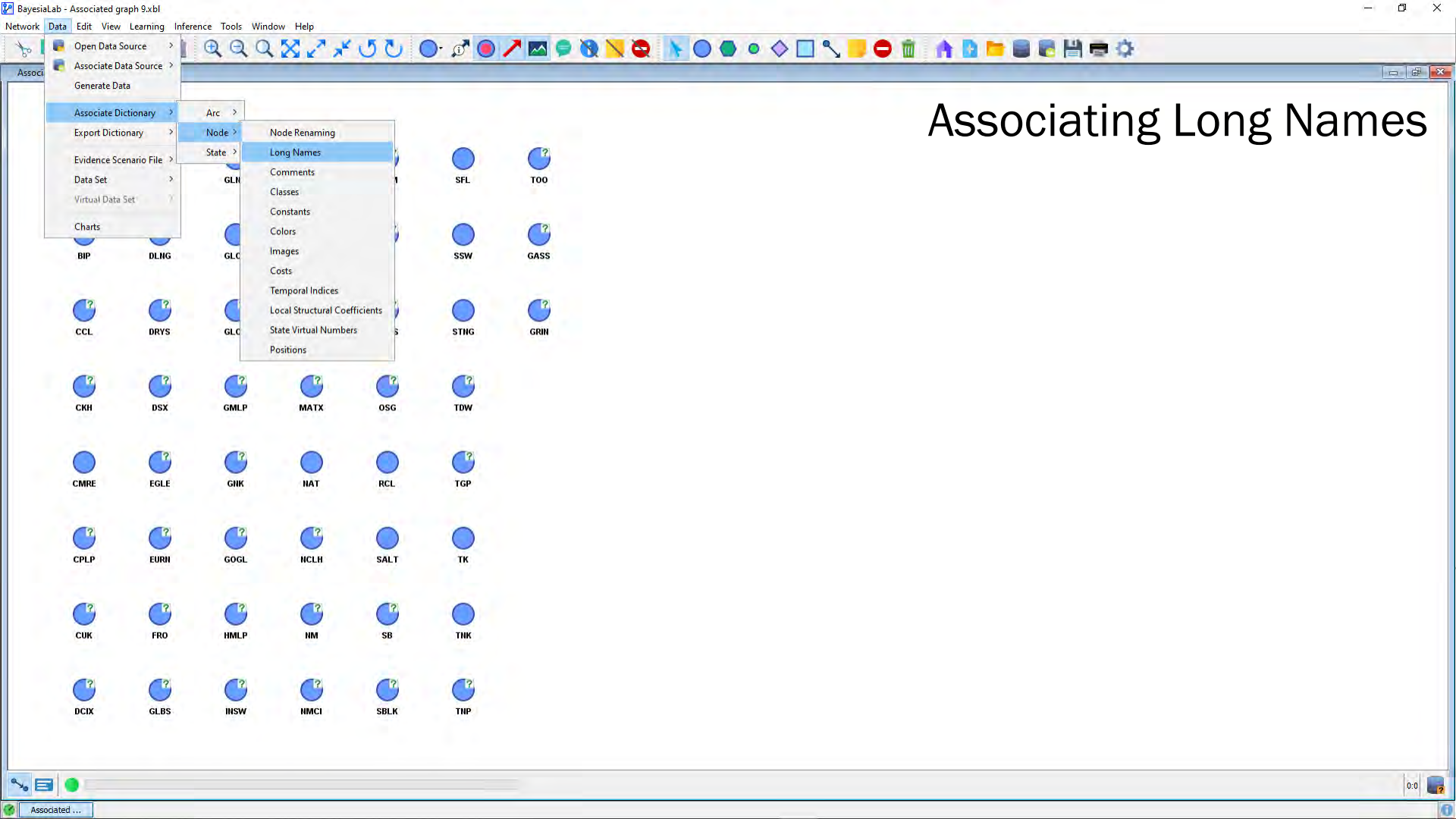
Discretization



Associated graph 9.xbl *

Unconnected Network




BayesiaLab - Associated graph 9.xbl
Network
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Associate Data Source
Generate Data
Associate Dictionary
Export Dictionary
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Virtual Data Set
Charts
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Colors
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Local Structural Coefficients
State Virtual Numbers
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Associating Long Names
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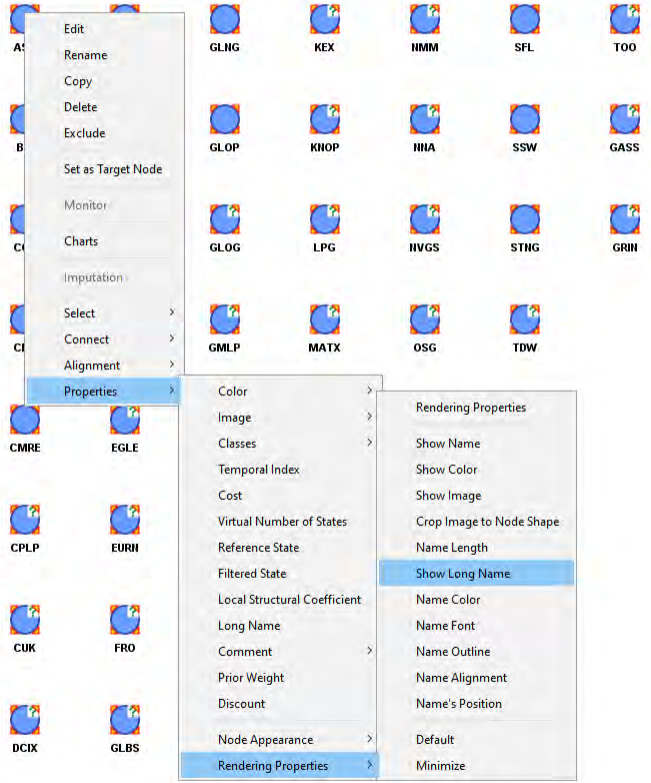
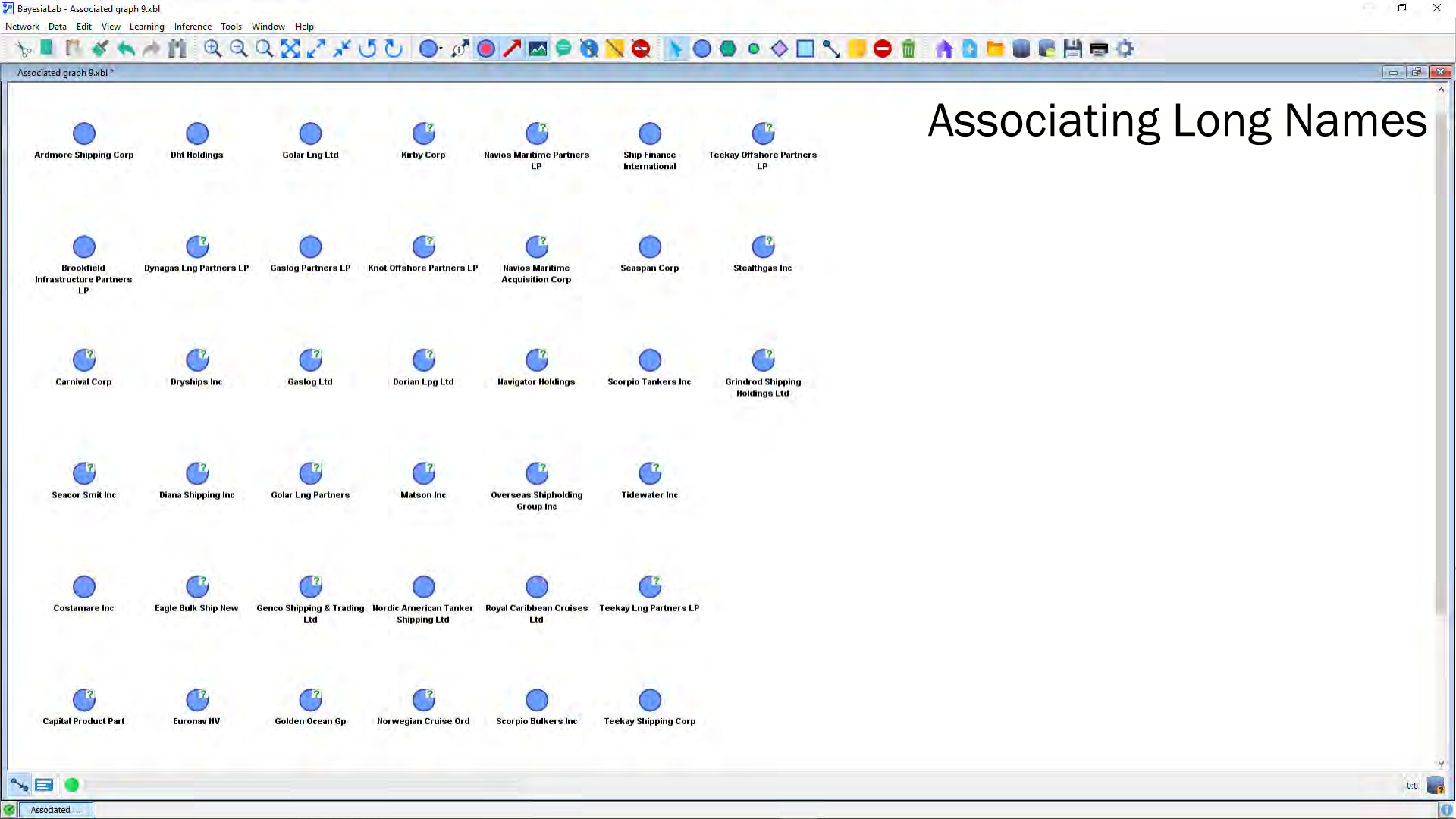
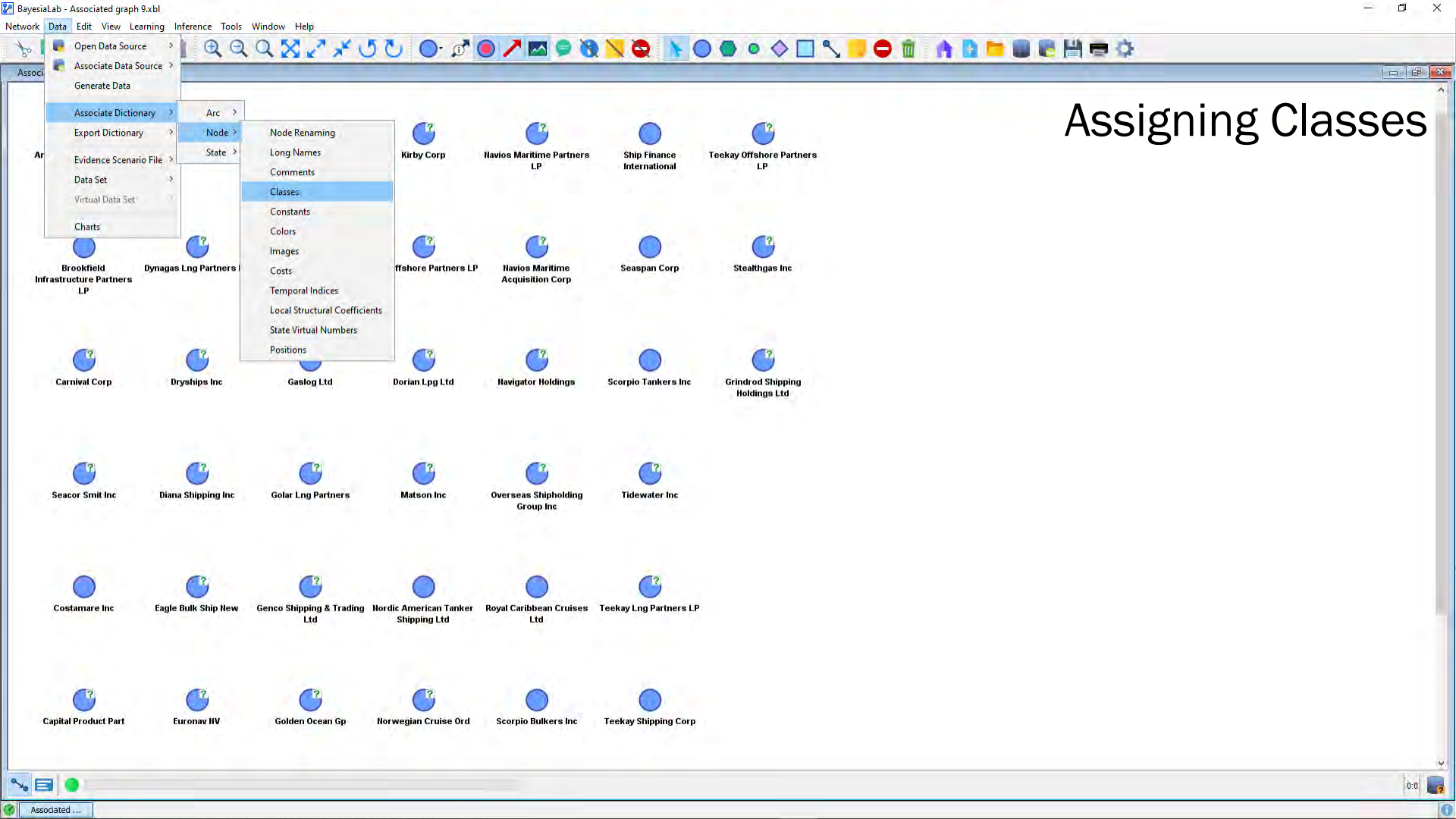
Associated ...

Associating Long Names





Associating Long Names


BayesiaLab - Associated graph 9.xbl
Network
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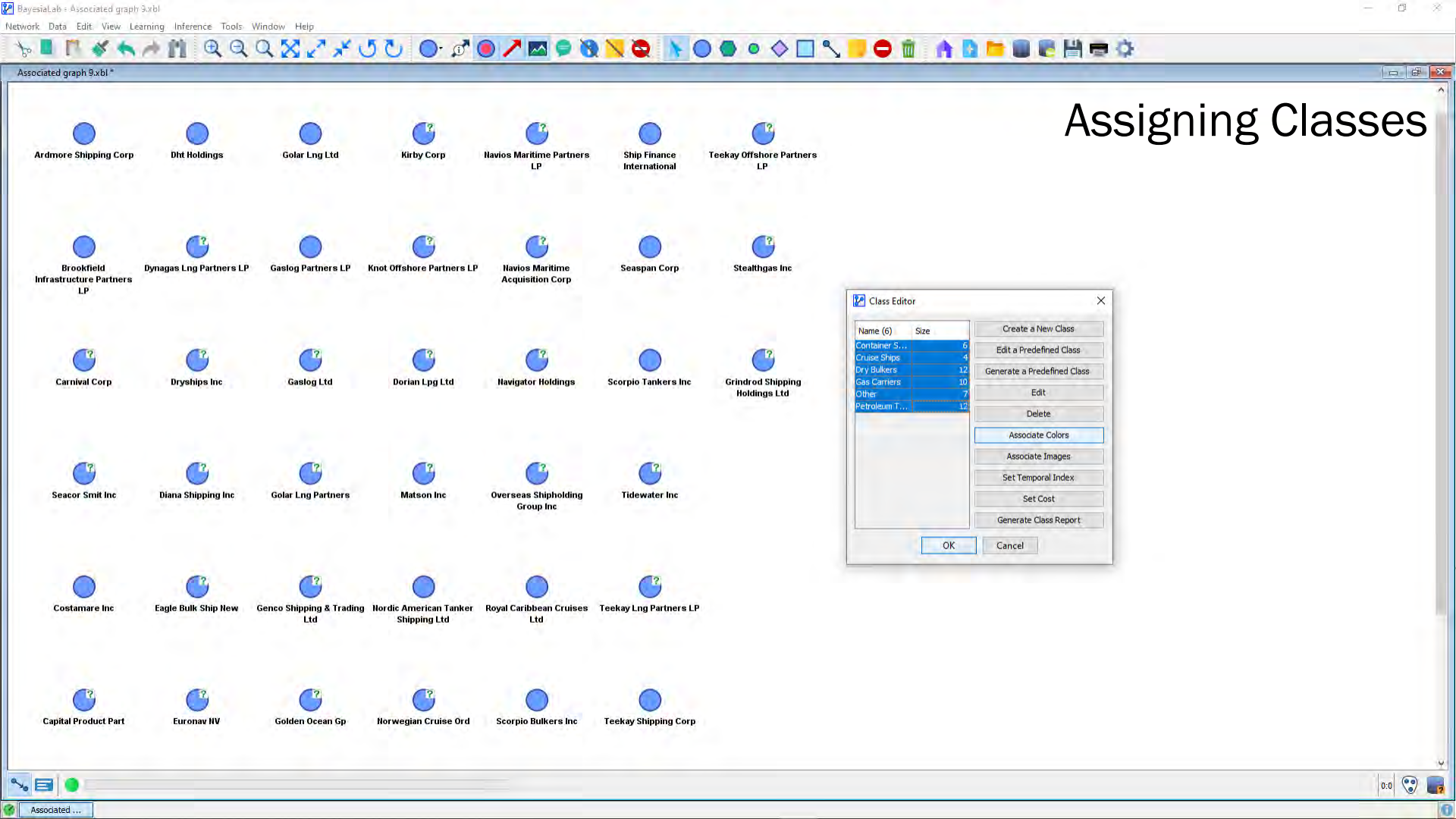
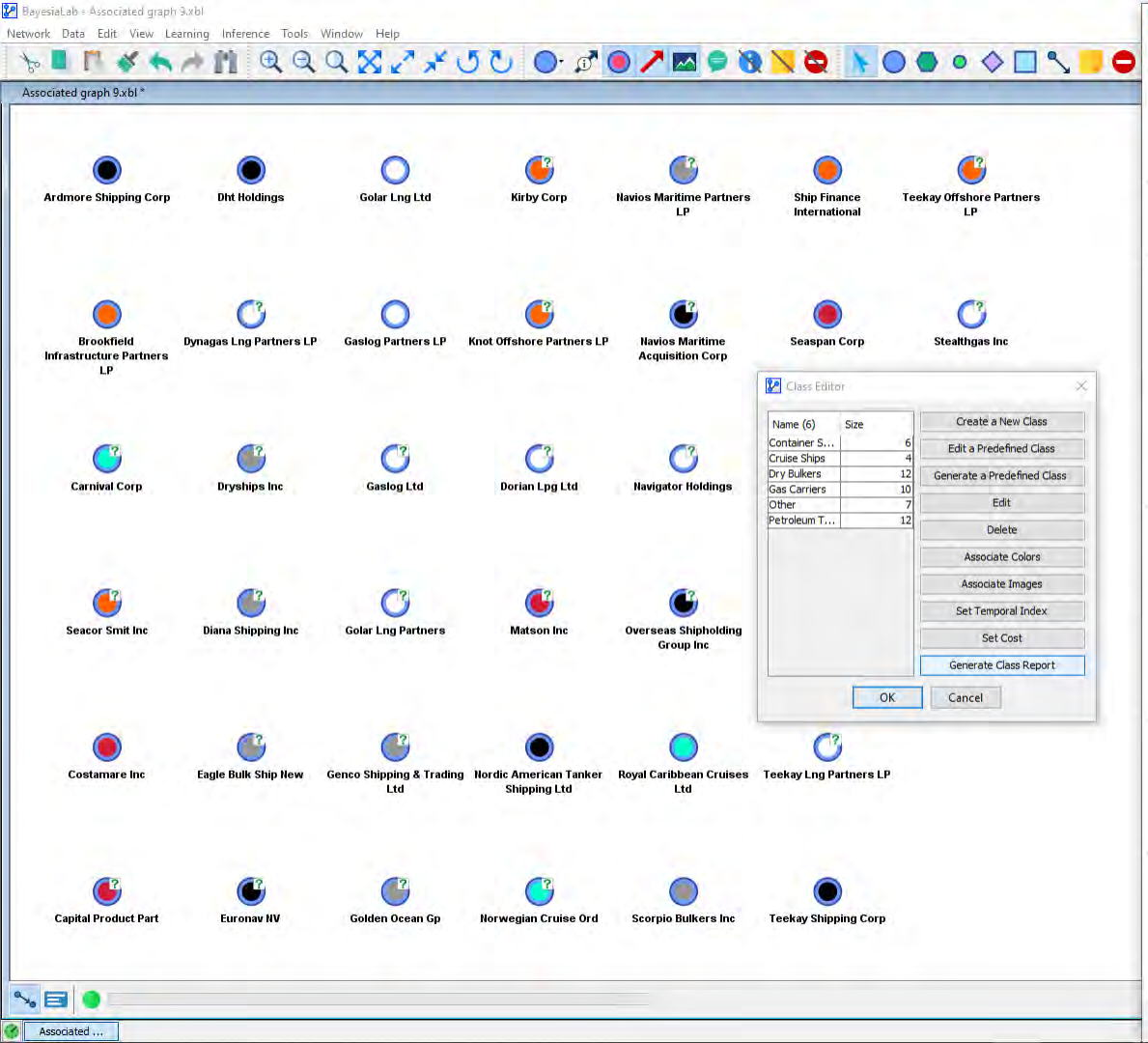
Window
Help
Open Data Source
Associate Data Source
Generate Data
Associate Dictionary
Export Dictionary
Evidence Scenario File
Data Set
Virtual Data Set
Charts
Arc
Node
State
Node Renaming
Long Names
Comments
Classes
Constants
Colors
Images
Costs
Temporal Indices
Local Structural Coefficients
State Virtual Numbers
Positions
Assigning Classes
Kirby Corp
Navios Maritime Partners LP
Ship Finance International
Teekay Offshore Partners LP
Brookfield Infrastructure Partners LP
Navios Maritime Acquisition Corp
Seaspan Corp
Stealthgas Inc
Carnival Corp
Dryships Inc
Gaslog Ltd
Dorian Lpg Ltd
Navigator Holdings
Scorpio Tankers Inc
Grindrod Shipping Holdings Ltd
Seacor Smit Inc
Diana Shipping Inc
Golar Lng Partners
Matson Inc
Overseas Shipholding Group Inc
Tidewater Inc
Costamare Inc
Eagle Bulk Ship New
Genco Shipping & Trading Ltd
Nordic American Tanker Shipping Ltd
Royal Caribbean Cruises Ltd
Teekay Lng Partners LP
Capital Product Part
Euronav NV
Golden Ocean Gp
Norwegian Cruise Ord
Scorpio Bulkers Inc
Teekay Shipping Corp
Associated ...

Assigning Classes



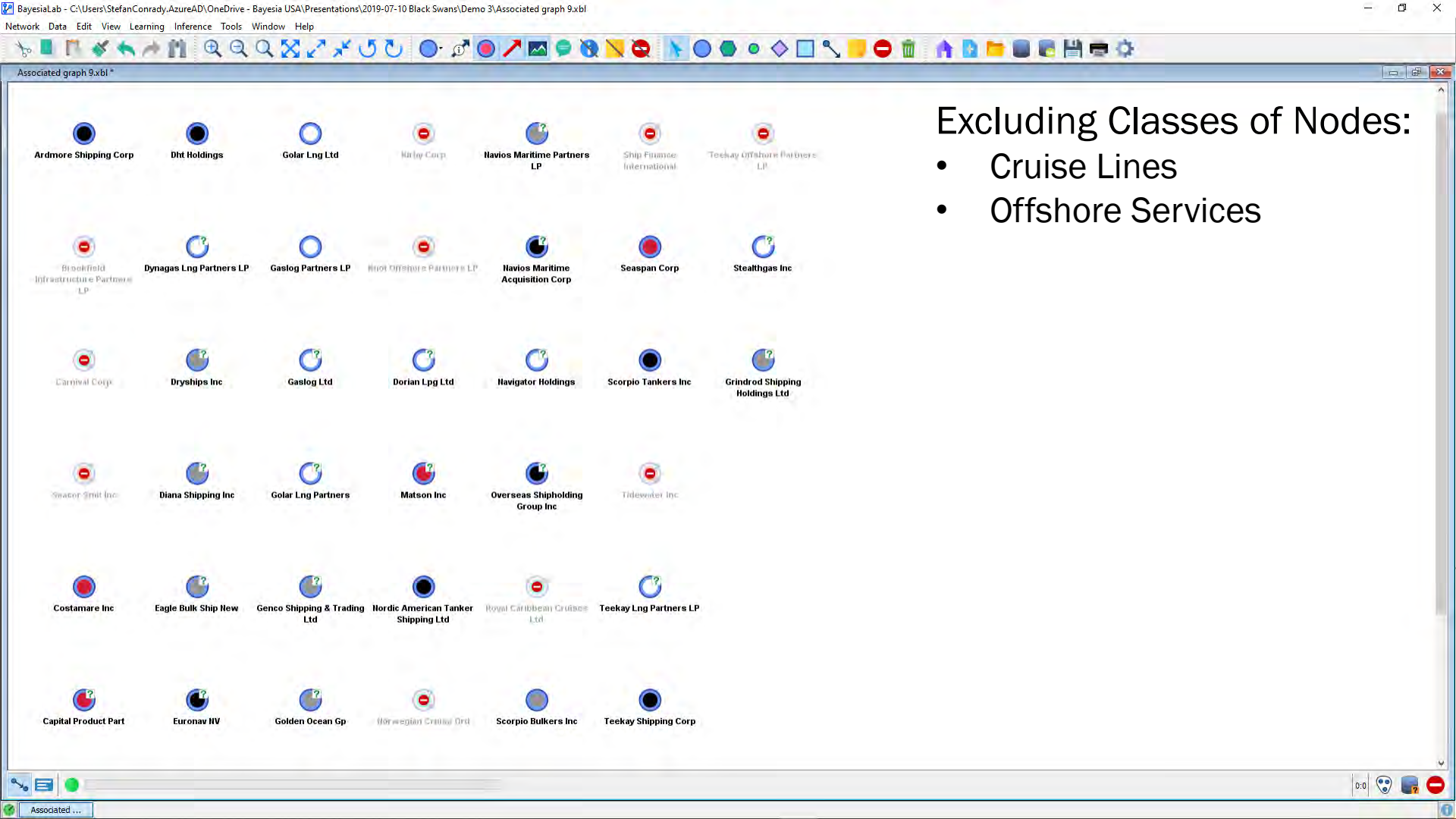
Assigning Classes



Class report

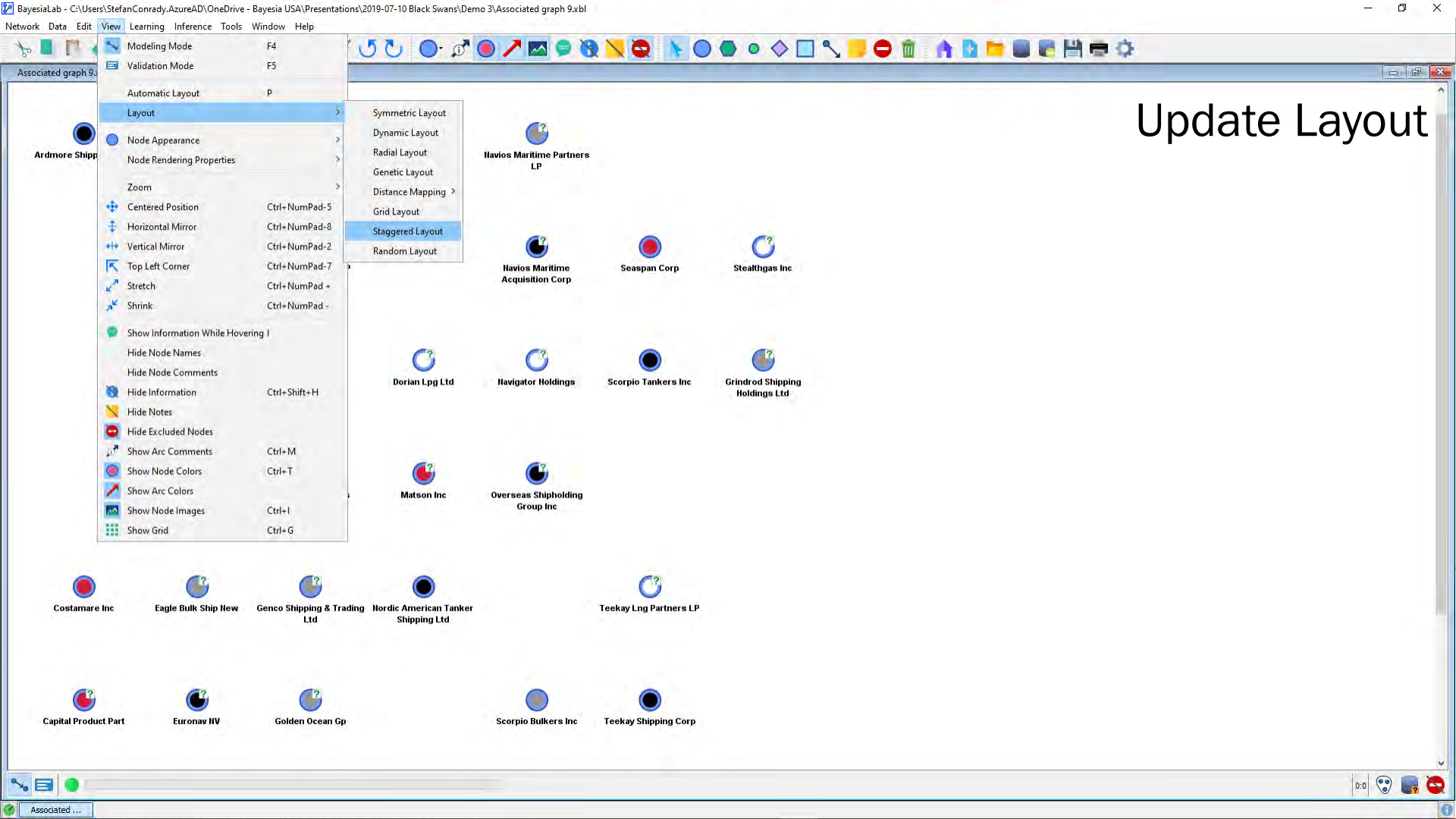
Classes	Nodes
Container Ships	Costamare Inc
	Capital Product Part
	Diana Containerships Inc
	Matson Inc
	Navios Maritime Containers L.P.
	Seaspan Corp
Cruise Ships	Carnival Corp
	Carnival Plc ADR
	Norwegian Cruise Ord
	Royal Caribbean Cruises Ltd
Dry Bulkers	Dryships Inc
	Diana Shipping Inc
	Eagle Bulk Ship New
	Globus Maritime Limi
	Genco Shipping & Trading Ltd
	Golden Ocean Gp
	Grindrod Shipping Holdings Ltd
	Navios Maritime Partners LP
	Navios Maritime Holdings Inc
	Scorpio Bulkers Inc
	Star Bulk Carriers
	Safe Bulkers Inc
Gas Carriers	Dynagas Lng Partners LP
	Stealthgas Inc
	Golar Lng Ltd
	Gaslog Ltd
	Gaslog Partners LP
	Golar Lng Partners
	Hoegh Lng Partners LP
	Dorian Lpg Ltd
	Navigator Holdings
	Teekay Lng Partners LP
Other	Brookfield Infrastructure Partners LP
	Seacor Smit Inc
	Kirby Corp
	Knot Offshore Partners LP
	Ship Finance International
	Tidewater Inc
	Teekay Offshore Partners LP
Petroleum Tankers	Ardmore Shipping Corp
	Dht Holdings
	Euronav NV
	Frontline Ltd
	International Seaways Inc
	Nordic American Tanker Shipping Ltd
	Navios Maritime Acquisition Corp

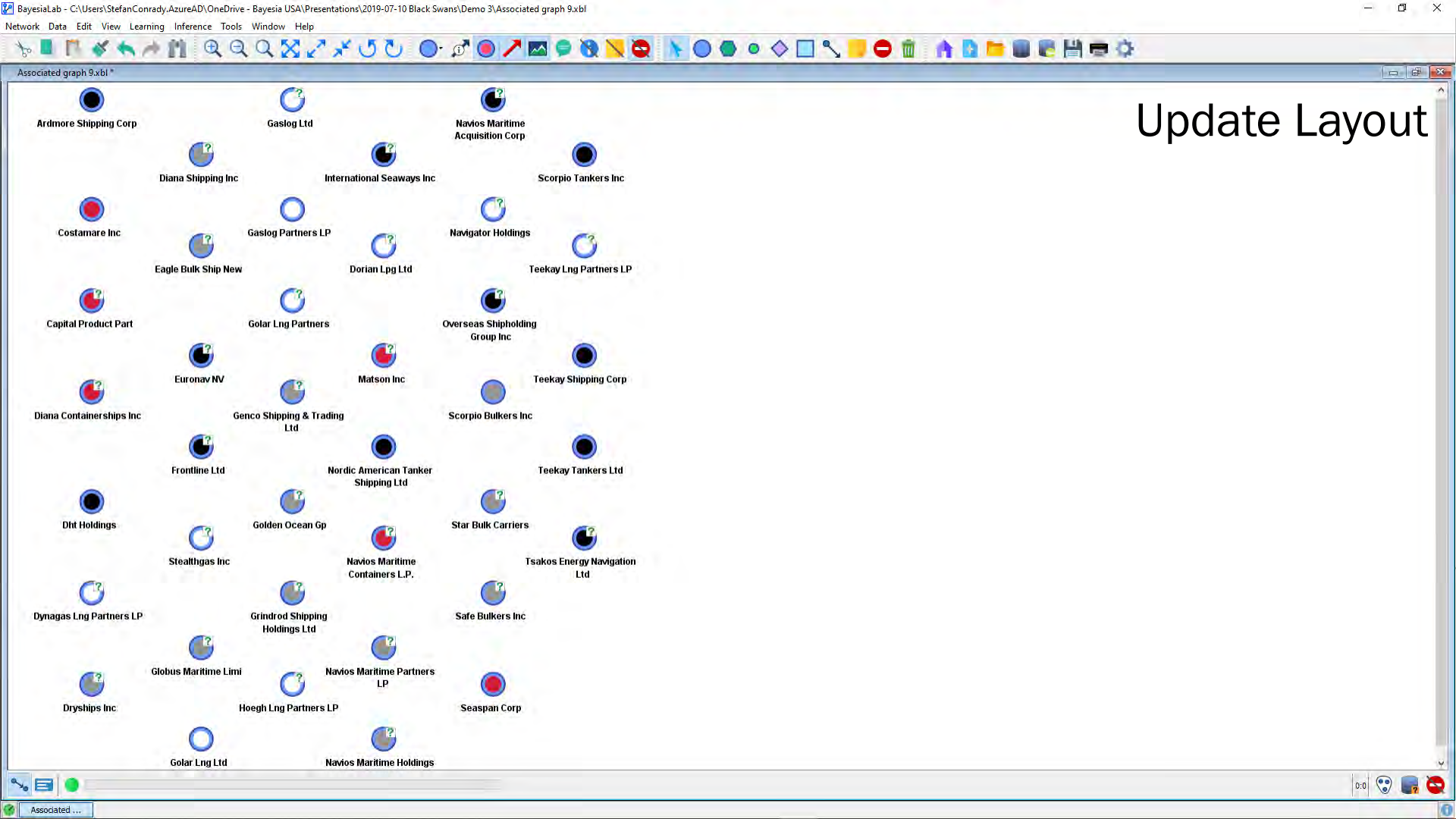
Close Save As... Print

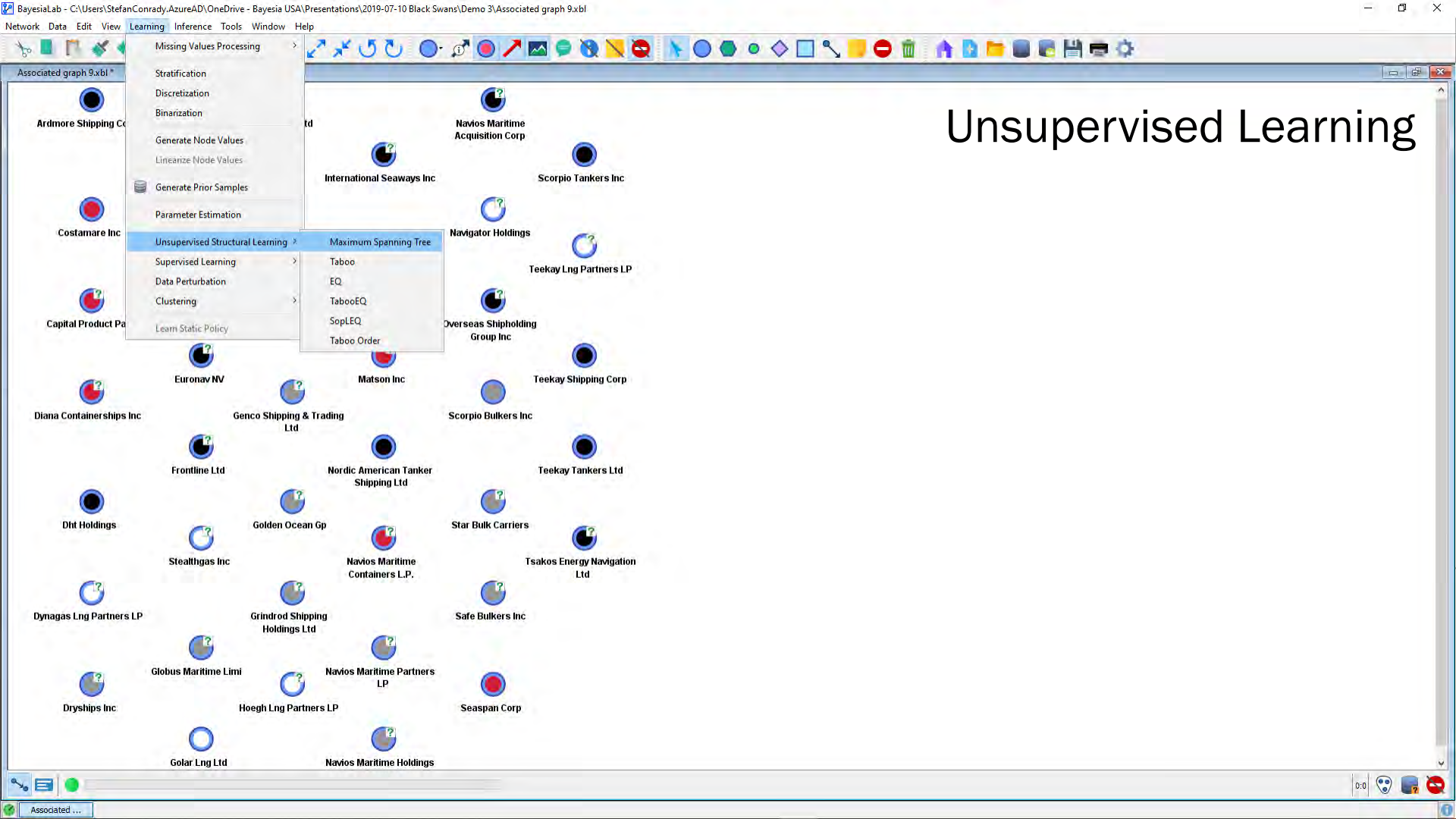


Excluding Classes of Nodes:

- Cruise Lines
- Offshore Services

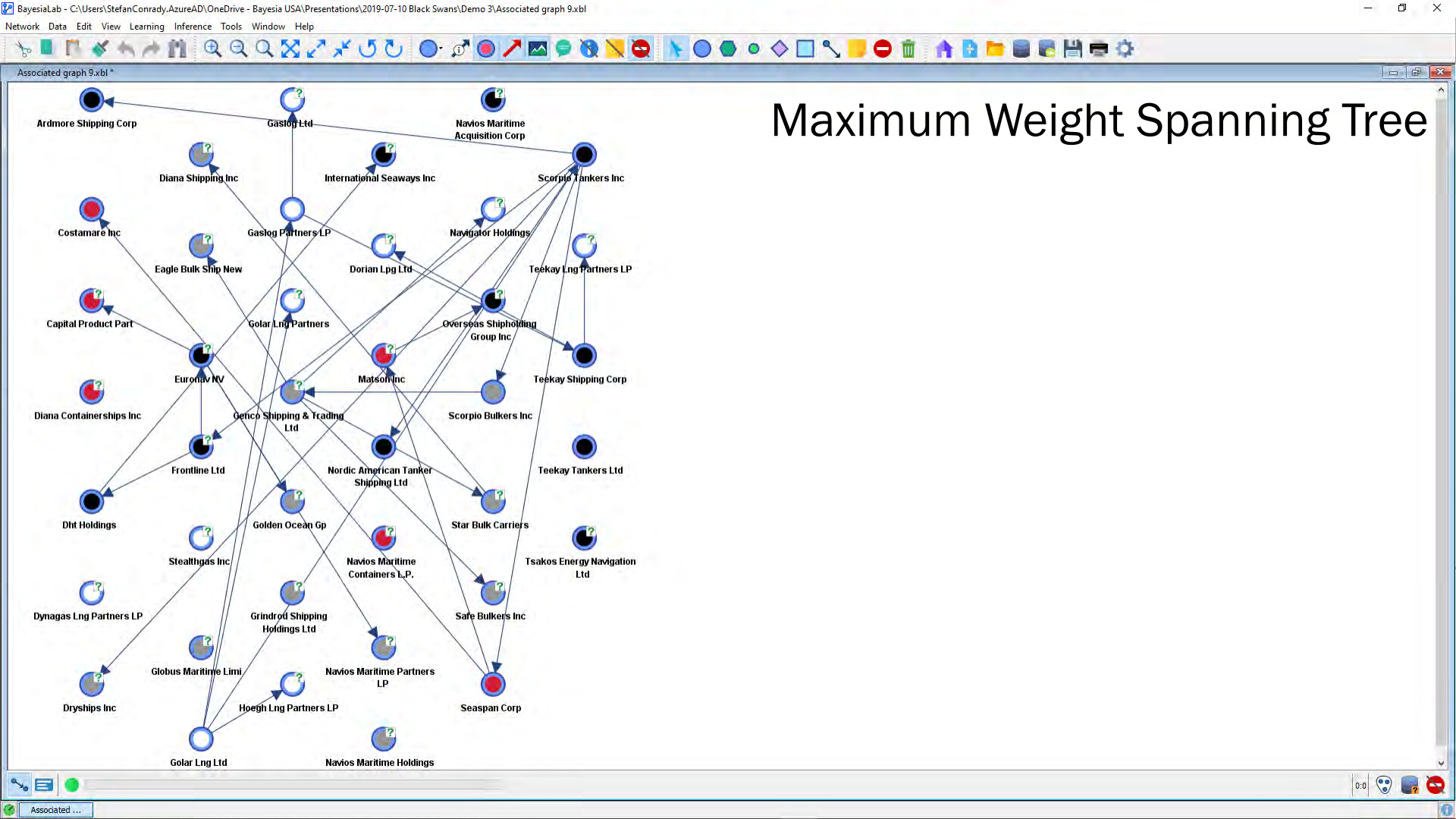

BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-10 Black Swans\Demo 3\Associated graph 9.xbl
Network Data Edit View Learning Inference Tools Window Help
Modeling Mode F4
Validation Mode F5
Automatic Layout P
Layout
Node Appearance
Node Rendering Properties
Zoom
Centered Position Ctrl+NumPad-5
Horizontal Mirror Ctrl+NumPad-8
Vertical Mirror Ctrl+NumPad-2
Top Left Corner Ctrl+NumPad-7
Stretch Ctrl+NumPad +
Shrink Ctrl+NumPad -
Show Information While Hovering I
Hide Node Names
Hide Node Comments
Hide Information Ctrl+Shift+H
Hide Notes
Hide Excluded Nodes
Show Arc Comments Ctrl+M
Show Node Colors Ctrl+T
Show Arc Colors
Show Node Images Ctrl+I
Show Grid Ctrl+G
Symmetric Layout
Dynamic Layout
Radial Layout
Genetic Layout
Distance Mapping
Grid Layout
Staggered Layout
Random Layout
Update Layout
Navios Maritime Partners LP
Navios Maritime Acquisition Corp
Seaspan Corp
Stealthgas Inc
Dorian Lpg Ltd
Navigator Holdings
Scorpio Tankers Inc
Grindrod Shipping Holdings Ltd
Matson Inc
Overseas Shipholding Group Inc
Costamare Inc
Eagle Bulk Ship New
Genco Shipping & Trading Ltd
Nordic American Tanker Shipping Ltd
Teekay Lng Partners LP
Capital Product Part
Euronav NV
Golden Ocean Gp
Scorpio Bulkers Inc
Teekay Shipping Corp
Associated ...


BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-10 Black Swans\Demo 3\Associated graph 9.xbl
Network Data Edit View Learning Inference Tools Window Help
Associated graph 9.xbl *
Ardmore Shipping Corp
Gaslog Ltd
Navios Maritime Acquisition Corp
Diana Shipping Inc
International Seaways Inc
Scorpio Tankers Inc
Costamare Inc
Gaslog Partners LP
Navigator Holdings
Eagle Bulk Ship New
Dorian Lpg Ltd
Teekay Lng Partners LP
Capital Product Part
Golar Lng Partners
Overseas Shipholding Group Inc
Euronav NV
Matson Inc
Teekay Shipping Corp
Diana Containerships Inc
Genco Shipping & Trading Ltd
Scorpio Bulkers Inc
Frontline Ltd
Nordic American Tanker Shipping Ltd
Teekay Tankers Ltd
Dht Holdings
Golden Ocean Gp
Star Bulk Carriers
Stealthgas Inc
Navios Maritime Containers L.P.
Tsakos Energy Navigation Ltd
Dynagas Lng Partners LP
Grindrod Shipping Holdings Ltd
Safe Bulkers Inc
Globus Maritime Limi
Navios Maritime Partners LP
Dryships Inc
Hoegh Lng Partners LP
Seaspan Corp
Golar Lng Ltd
Navios Maritime Holdings
Update Layout
Associated ...



Unsupervised Learning

Maximum Weight Spanning Tree



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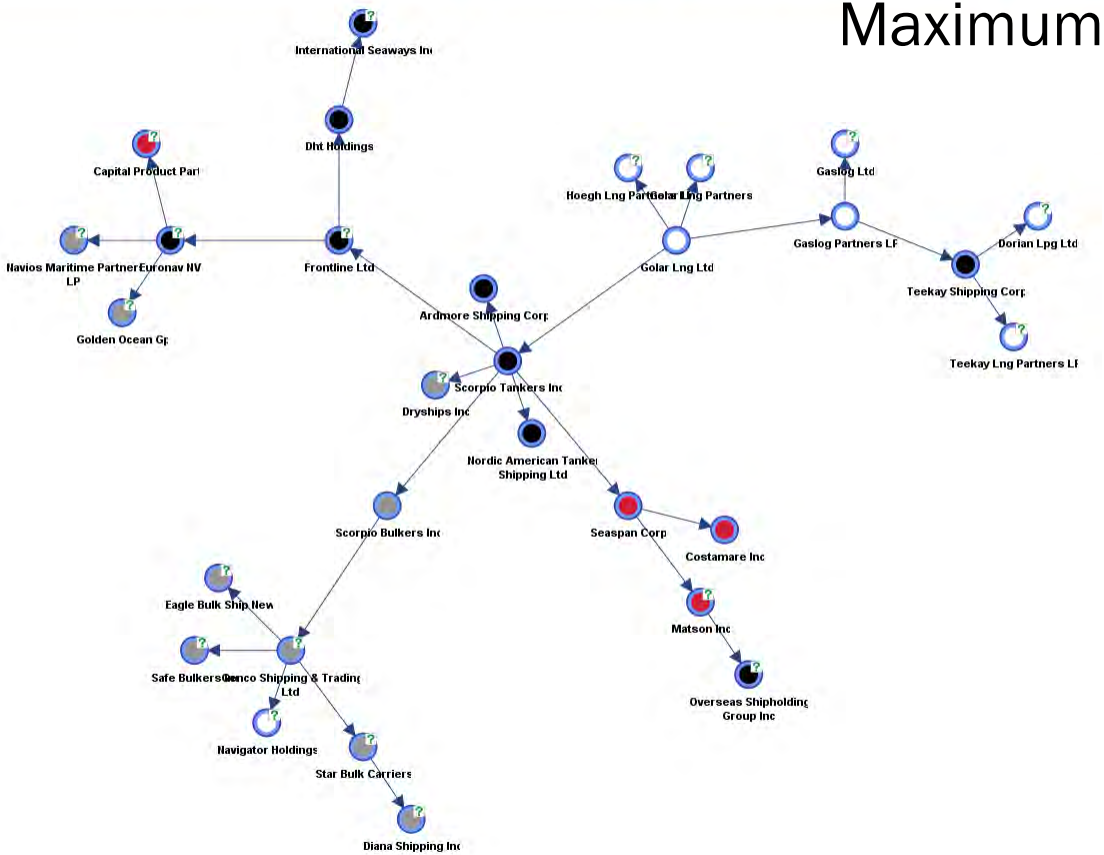
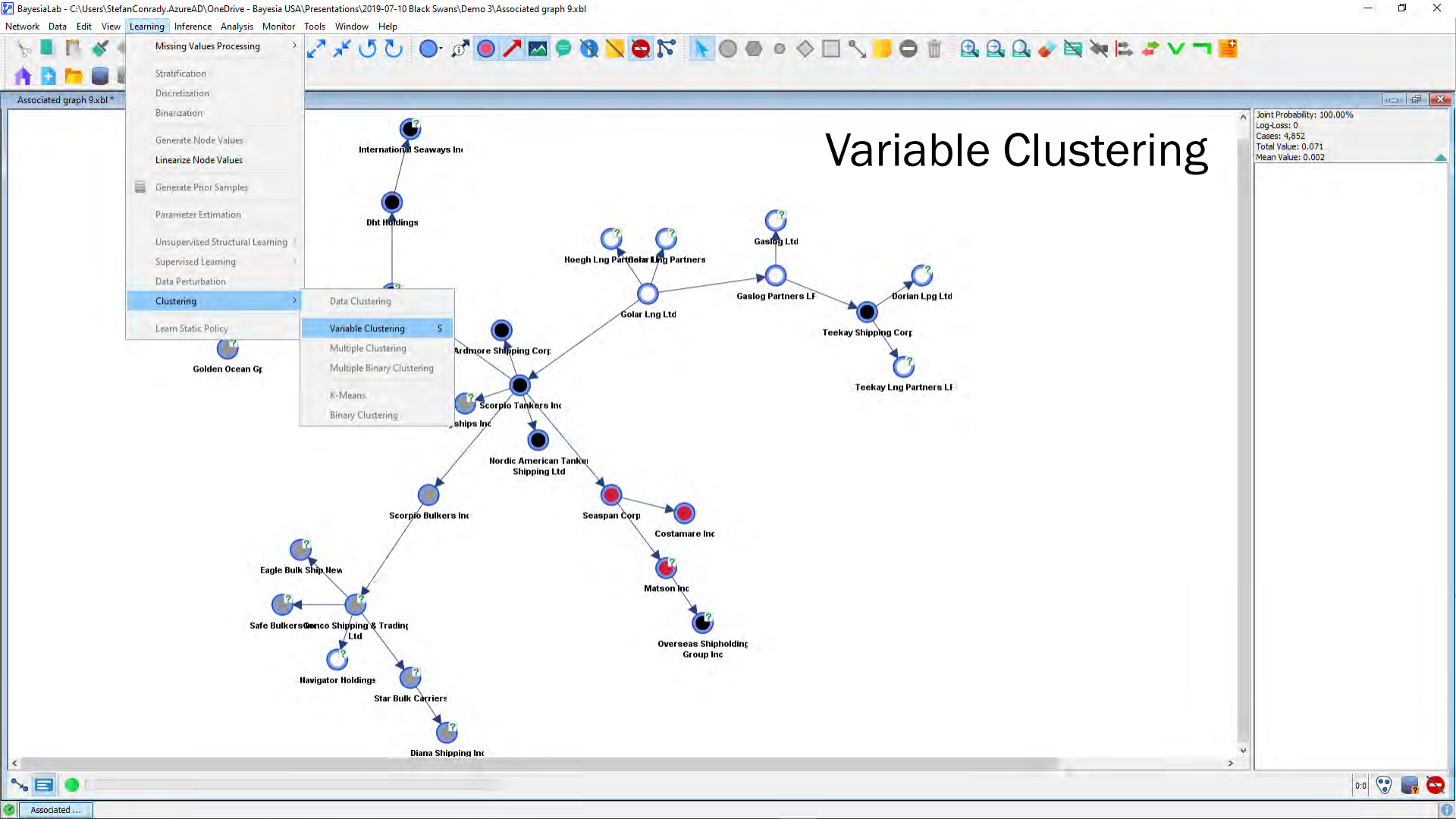
Network Data Edit View Learning Inference Tools Window Help

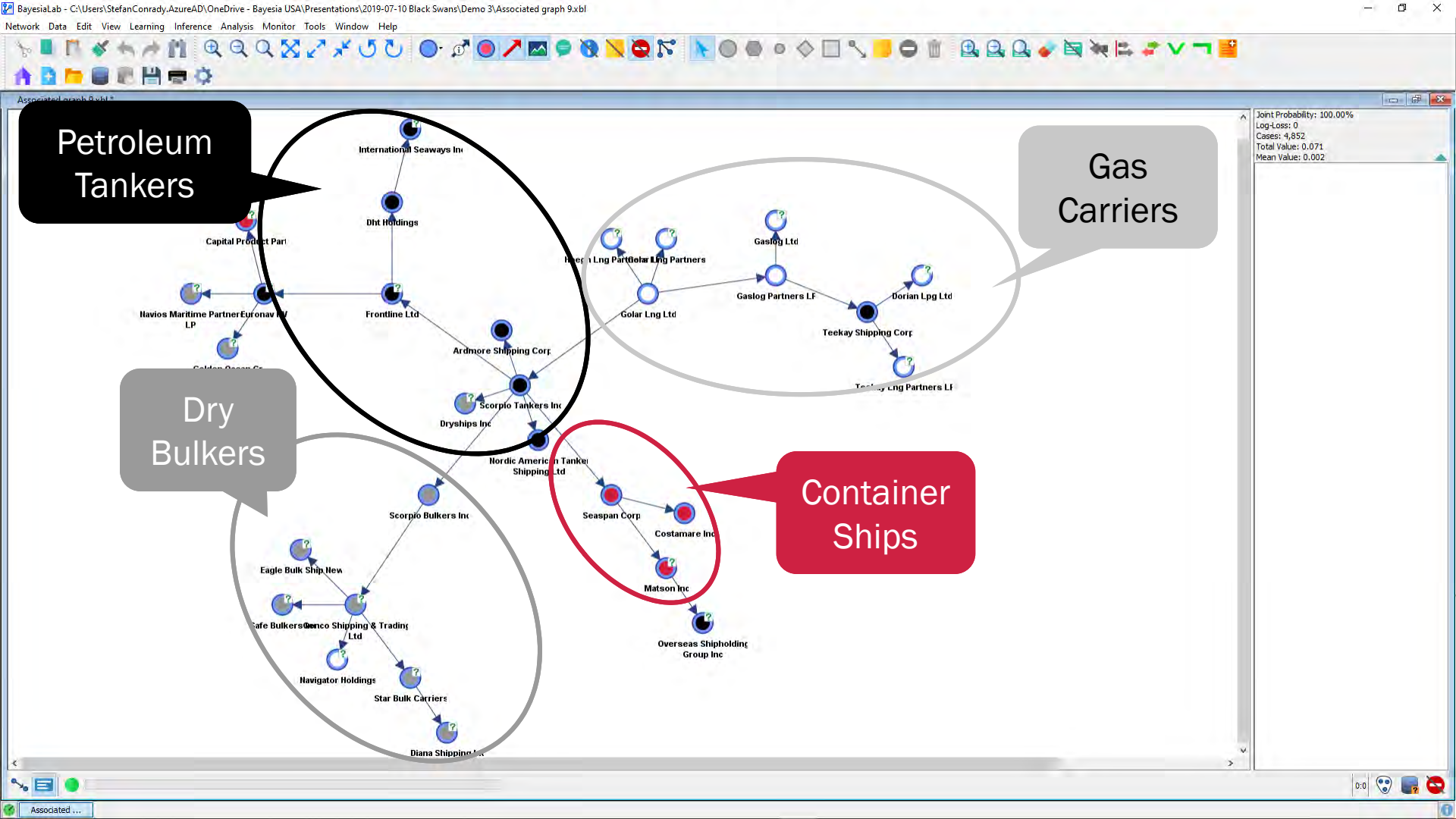
Associated graph 9.xbl *

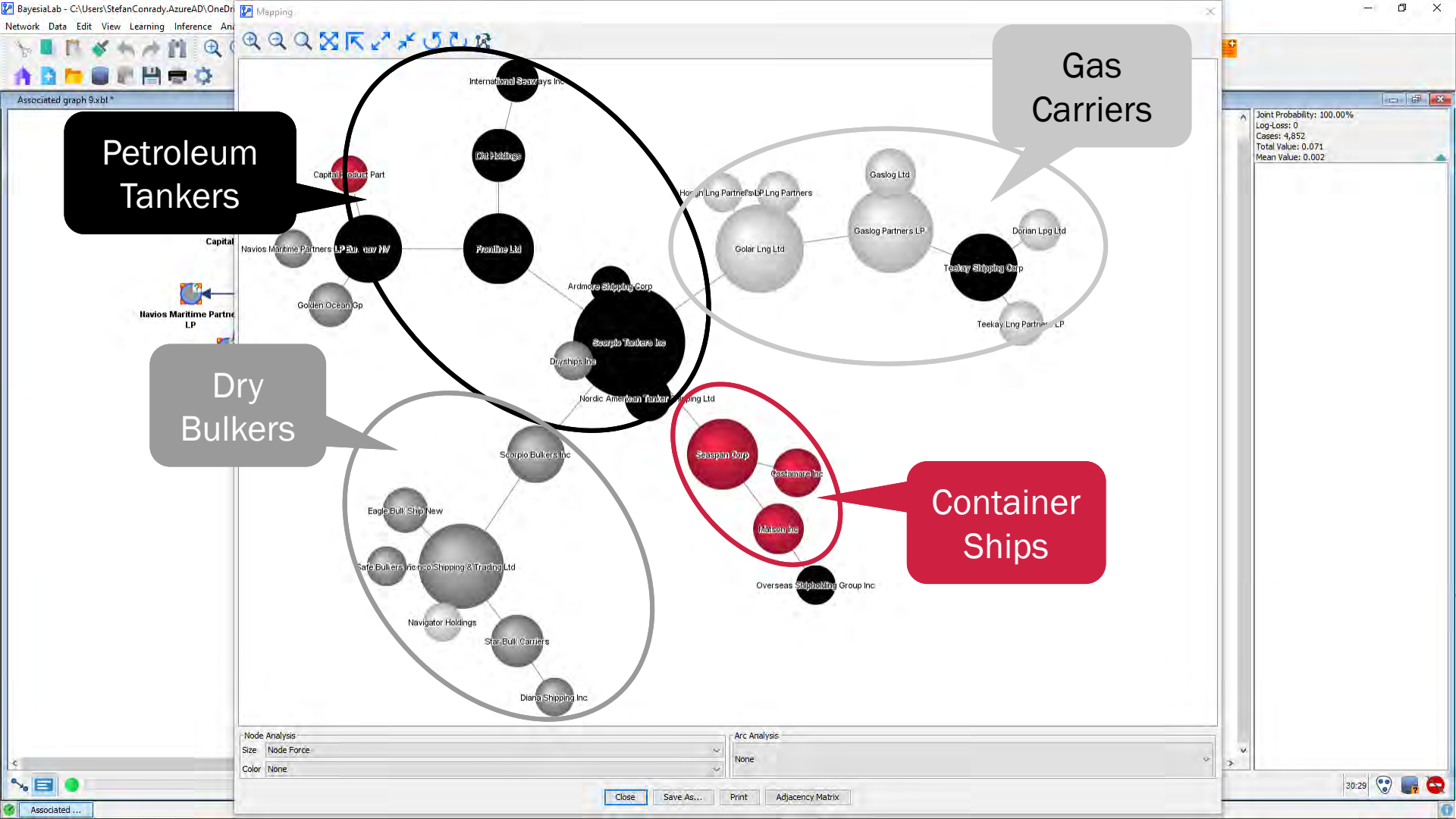
Maximum Weight Spanning Tree

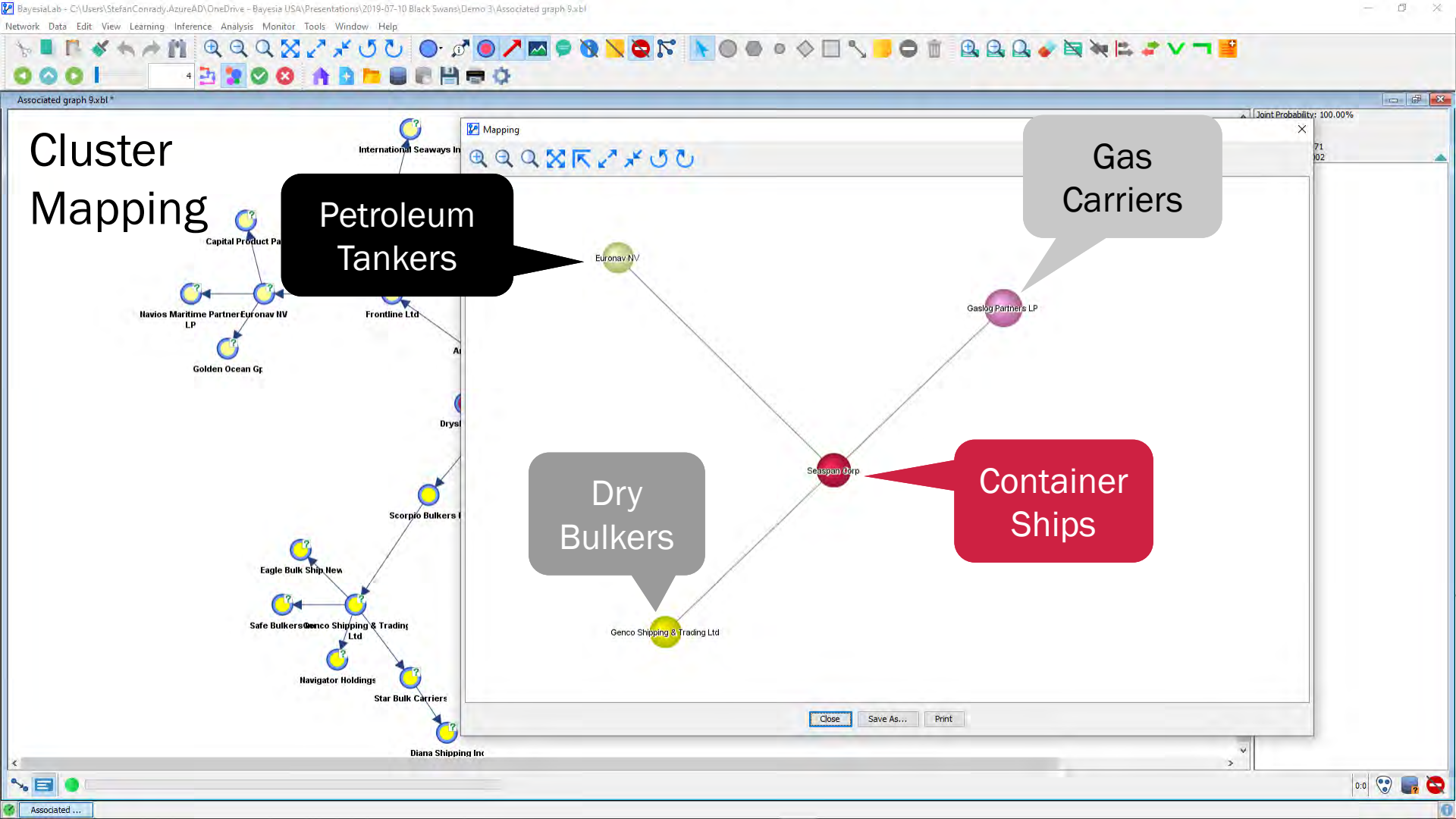


Associated ...


BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-10 Black Swans\Demo 3\Associated graph 9.xbl
Network Data Edit View Learning Inference Analysis Monitor Tools Window Help
Missing Values Processing
Stratification
Discretization
Binarization
Generate Node Values
Linearize Node Values
Generate Prior Samples
Parameter Estimation
Unsupervised Structural Learning
Supervised Learning
Data Perturbation
Clustering
Learn Static Policy
Data Clustering
Variable Clustering S
Multiple Clustering
Multiple Binary Clustering
K-Means
Binary Clustering
Associated graph 9.xbl *
Variable Clustering
International Seaways Inc
Dht Holdings
Golden Ocean Gr
Hoegh Lng Partners
Gaslog Ltd
Gaslog Partners LP
Golar Lng Ltd
Dorian Lpg Ltd
Teekay Shipping Corp
Teekay Lng Partners LP
Ardmore Shipping Corp
Scorpio Tankers Inc
Nordic American Tanker Shipping Ltd
Scorpio Bulkers Inc
Seaspan Corp
Costamare Inc
Matson Inc
Overseas Shipholding Group Inc
Eagle Bulk Ship New
Safe Bulkers Inc
Genco Shipping & Trading Ltd
Navigator Holdings
Star Bulk Carriers
Diana Shipping Inc
Joint Probability: 100.00%
Log-Loss: 0
Cases: 4,852
Total Value: 0.071
Mean Value: 0.002
Associated ...


BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-10 Black Swans\Demo 3\Associated graph 9.xbl
Network Data Edit View Learning Inference Analysis Monitor Tools Window Help
Petroleum Tankers
Gas Carriers
Dry Bulkers
Container Ships
International Seaways Inc
Dht Holdings
Capital Product Part
Navios Maritime Partner LP
Euronav NV
Frontline Ltd
Golden Ocean Gr
Ardmore Shipping Corp
Scorpio Tankers Inc
Dryships Inc
Nordic American Tanker Shipping Ltd
Golar Lng Partners
Golar Lng Ltd
Gaslog Ltd
Gaslog Partners LP
Dorian Lpg Ltd
Teekay Shipping Corp
Teekay Lng Partners LP
Scorpio Bulkers Inc
Eagle Bulk Ship New
Safe Bulkers Inc
Genco Shipping & Trading Ltd
Navigator Holdings
Star Bulk Carriers
Diana Shipping Inc
Seaspan Corp
Costamare Inc
Matson Inc
Overseas Shipholding Group Inc
Joint Probability: 100.00%
Log-Loss: 0
Cases: 4,852
Total Value: 0.071
Mean Value: 0.002
Associated ...


Petroleum Tankers
Gas Carriers
Dry Bulkers
Container Ships
International Seaways Inc
Dht Holdings
Capital Product Part
Navios Maritime Partners LP
Frontline Ltd
Golden Ocean Gp
Ardmore Shipping Corp
Scorpio Tankers Inc
Dryships Inc
Nordic American Tanker Shipping Ltd
Gaslog Ltd
Golar Lng Ltd
Gaslog Partners LP
Dorian Lpg Ltd
Teekay Shipping Corp
Seaspan Corp
Costamare Inc
Matson Inc
Overseas Shipholding Group Inc
Scorpio Bulkers Inc
Eagle Bulk Ship New
Navigator Holdings
Star Bulk Carriers
Diana Shipping Inc
Node Analysis
Size
Node Force
Color
None
Arc Analysis
None
Close
Save As...
Print
Adjacency Matrix


Cluster Mapping
Petroleum Tankers
Gas Carriers
Dry Bulkers
Container Ships
Mapping
Euronav NV
Gaslog Partners LP
Seaspan Corp
Genco Shipping & Trading Ltd
Close
Save As...
Print

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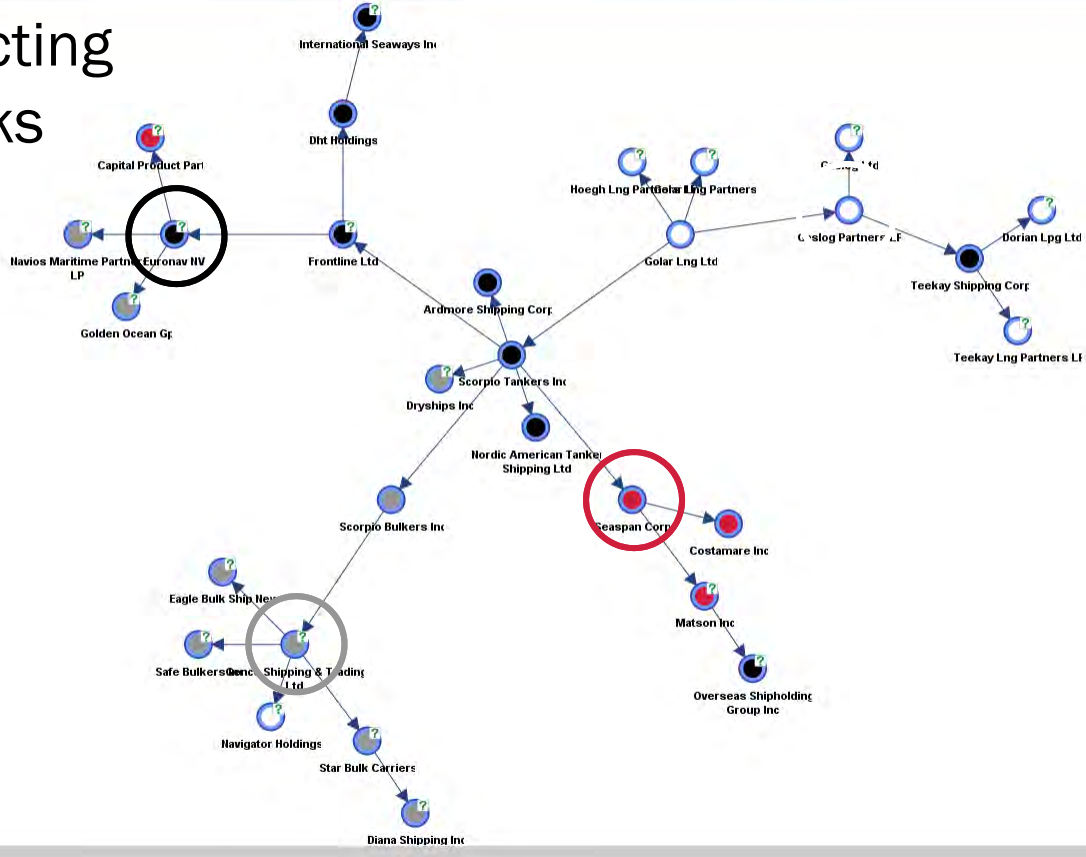
Network Data Edit View Learning Inference Analysis Monitor Tools Window Help

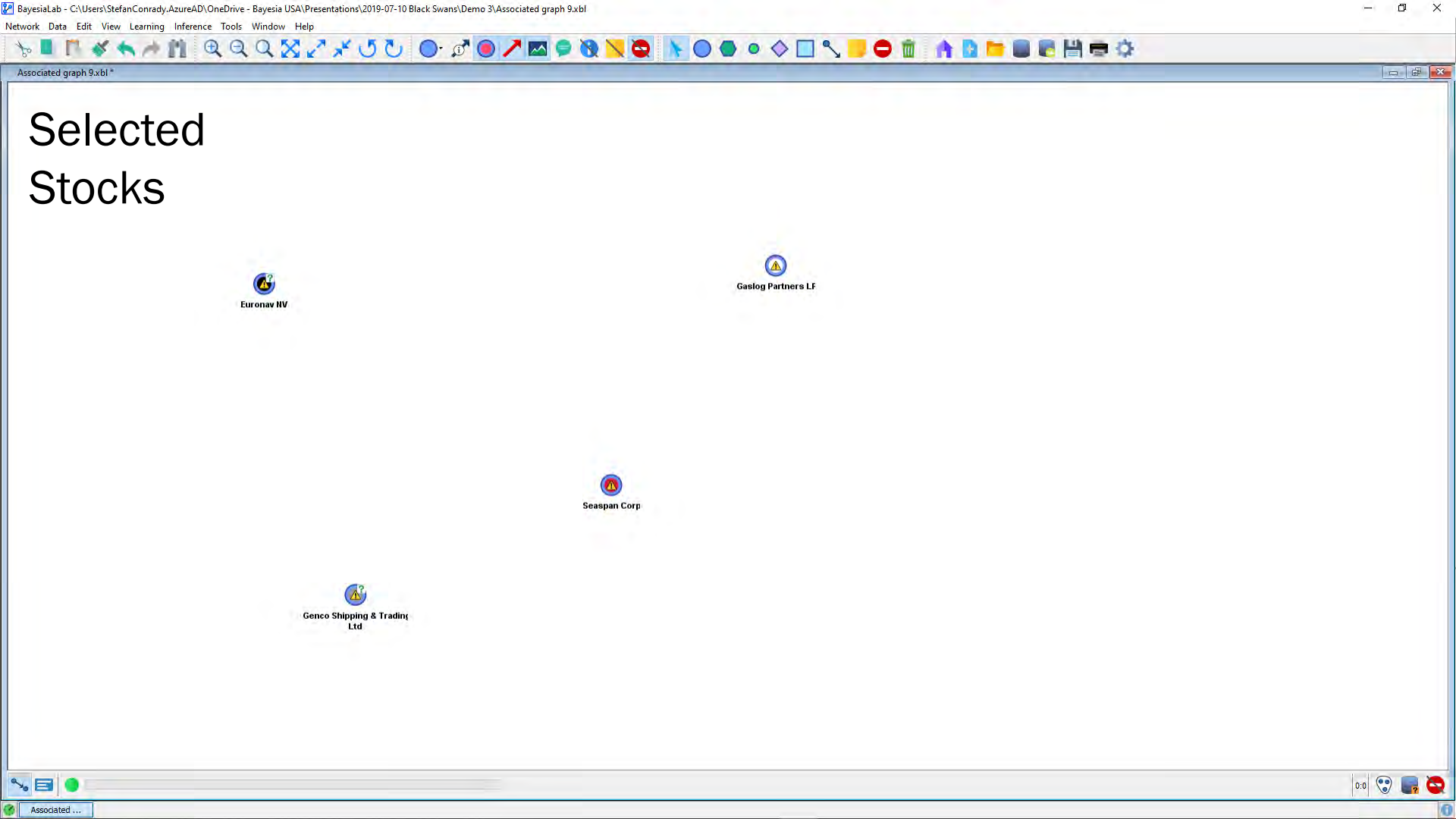
Associated graph 9.xbl *

Selecting Stocks

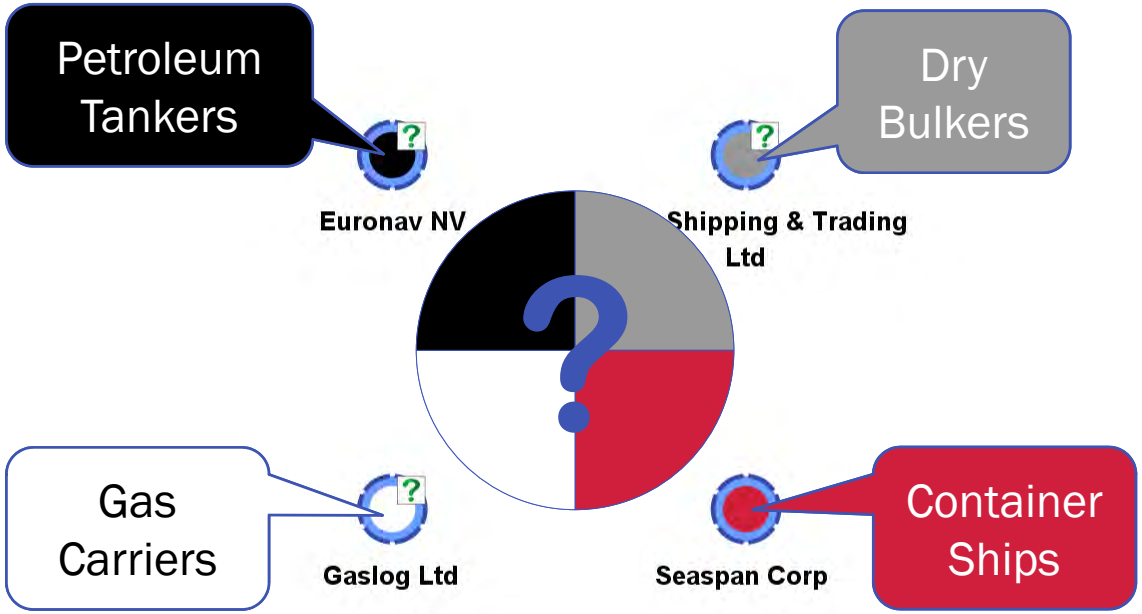


Joint Probability: 100.00%
Log-Loss: 0
Cases: 4,852
Total Value: 0.071
Mean Value: 0.002

Associated ...


BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-10 Black Swans\Demo 3\Associated graph 9.xbl
Network Data Edit View Learning Inference Tools Window Help
Associated graph 9.xbl *
Selected
Stocks
Euronav NV
Gaslog Partners LF
Seaspan Corp
Genco Shipping & Trading Ltd
Associated ...

Portfolio Allocation



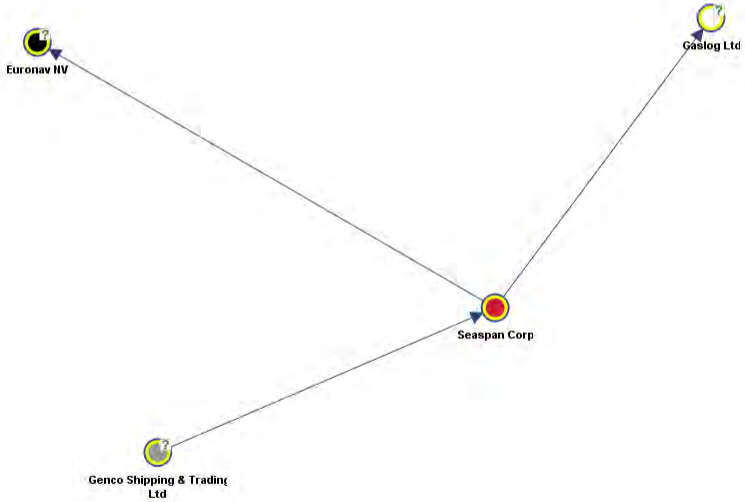
What is the optimum portfolio?

BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-10 Black Swans\Demo 3\Associated graph 9b.xbl

Network Data Edit View Learning Inference Analysis Monitor Tools Window Help

Associated graph 9b.xbl *

Unsupervised Learning



Joint Probability: 100.00%
Log-Loss: 0
Cases: 4,852
Total Value: 0.014
Mean Value: 0.003

GLOG
Mean: 0.002 Dev: 0.283
Value: 0.002

1.20%	<=-0.698
16.00%	<=-0.168
49.48%	<=0.076
29.90%	<=0.426
3.42%	>0.426

EURN
Mean: 0.005 Dev: 0.283
Value: 0.005

1.28%	<=-0.537
26.10%	<=-0.086
57.42%	<=0.146
13.92%	<=0.6
1.28%	>0.6

GNK
Mean: 0.005 Dev: 0.546
Value: 0.005

1.20%	<=-1.339
16.21%	<=-0.308
53.16%	<=0.176
25.67%	<=0.845
3.77%	>0.845

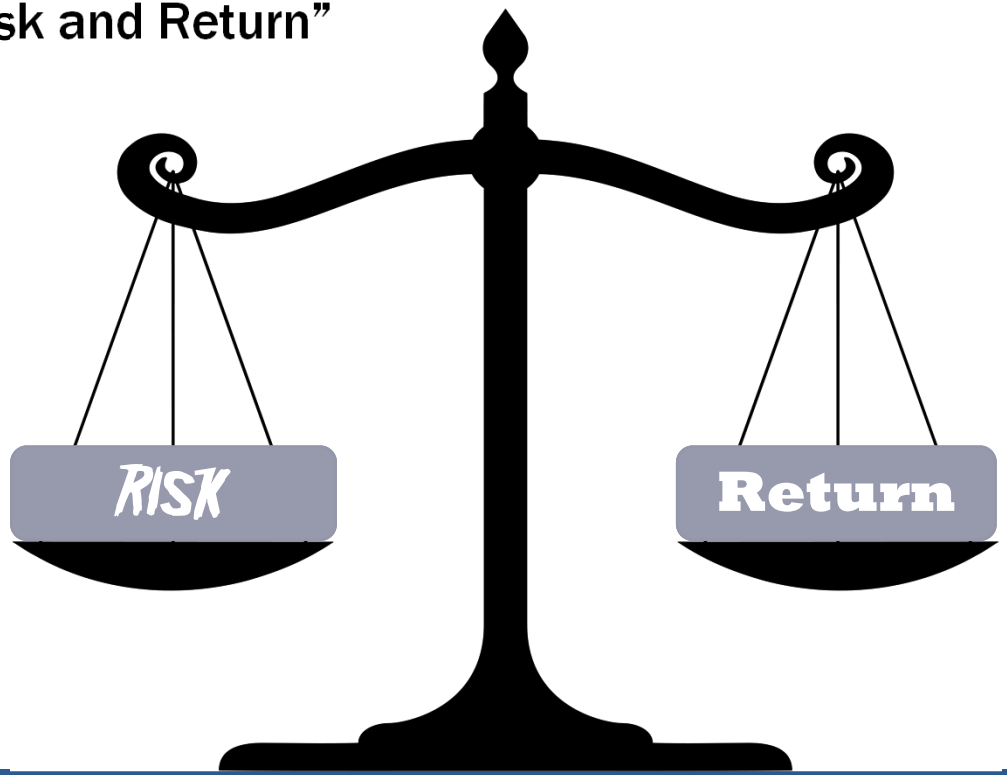
SSW
Mean: 0.003 Dev: 0.325
Value: 0.003

1.20%	<=-0.816
17.70%	<=-0.169
58.45%	<=0.146
20.47%	<=0.633
2.19%	>0.633

Associated ...

Modern Portfolio Theory

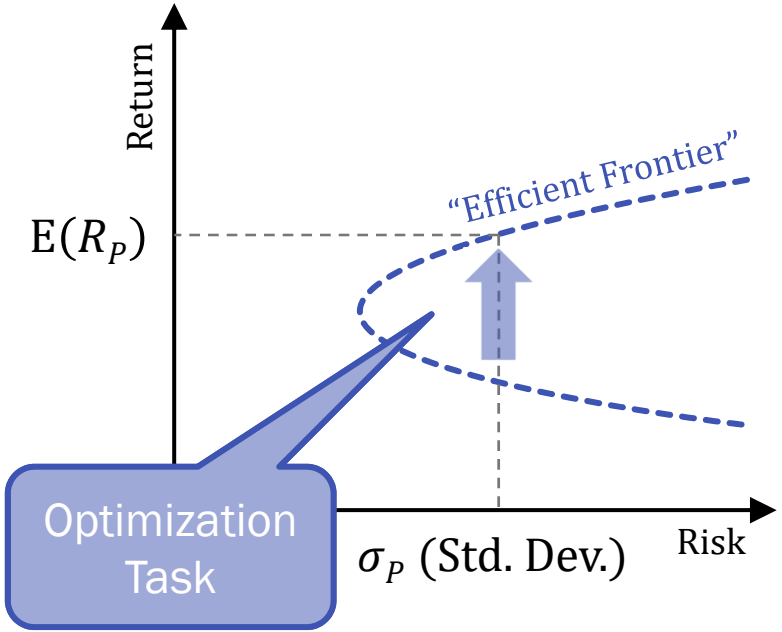
"Trading Off Risk and Return"



Modern Portfolio Theory

Risk and Return

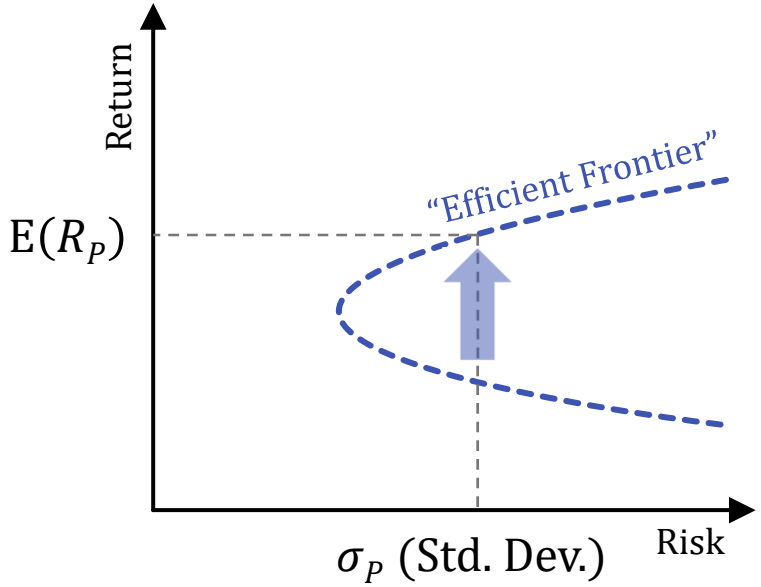
- Expected Return:
  - $\mathrm{E}(R_P) = w_A \mathrm{E}(R_A) + w_B \mathrm{E}(R_B)$
- Expected Return Variance:
  - $\sigma_P^2 = w_A^2 \sigma_A^2 + w_B^2 \sigma_B^2 + 2 w_A w_B \sigma_A \sigma_B \rho_{AB}$



Modern Portfolio Theory

Criticism

- Gaussian assumptions of return distributions in MPT may not hold.
- Variance is a symmetric measure, but risk is not symmetric, i.e., only “downside” is risk; “upside” is opportunity.
- MPT provides a statistical, not a structural model.



Modern Portfolio Theory

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Countermeasures

- Learn Bayesian Network
- Define New Risk Score
- Encode Assumptions

Modern Portfolio Theory

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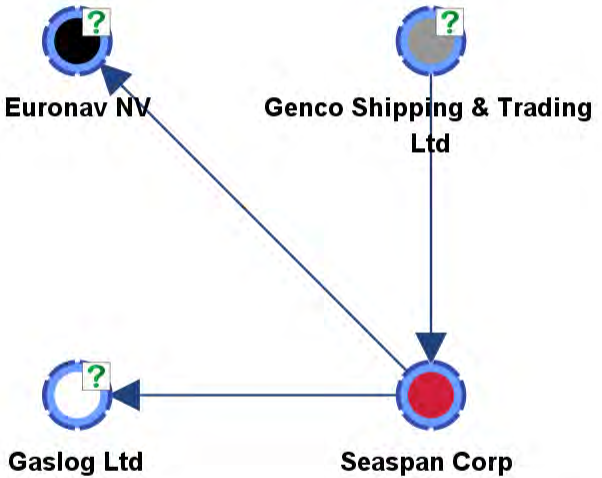
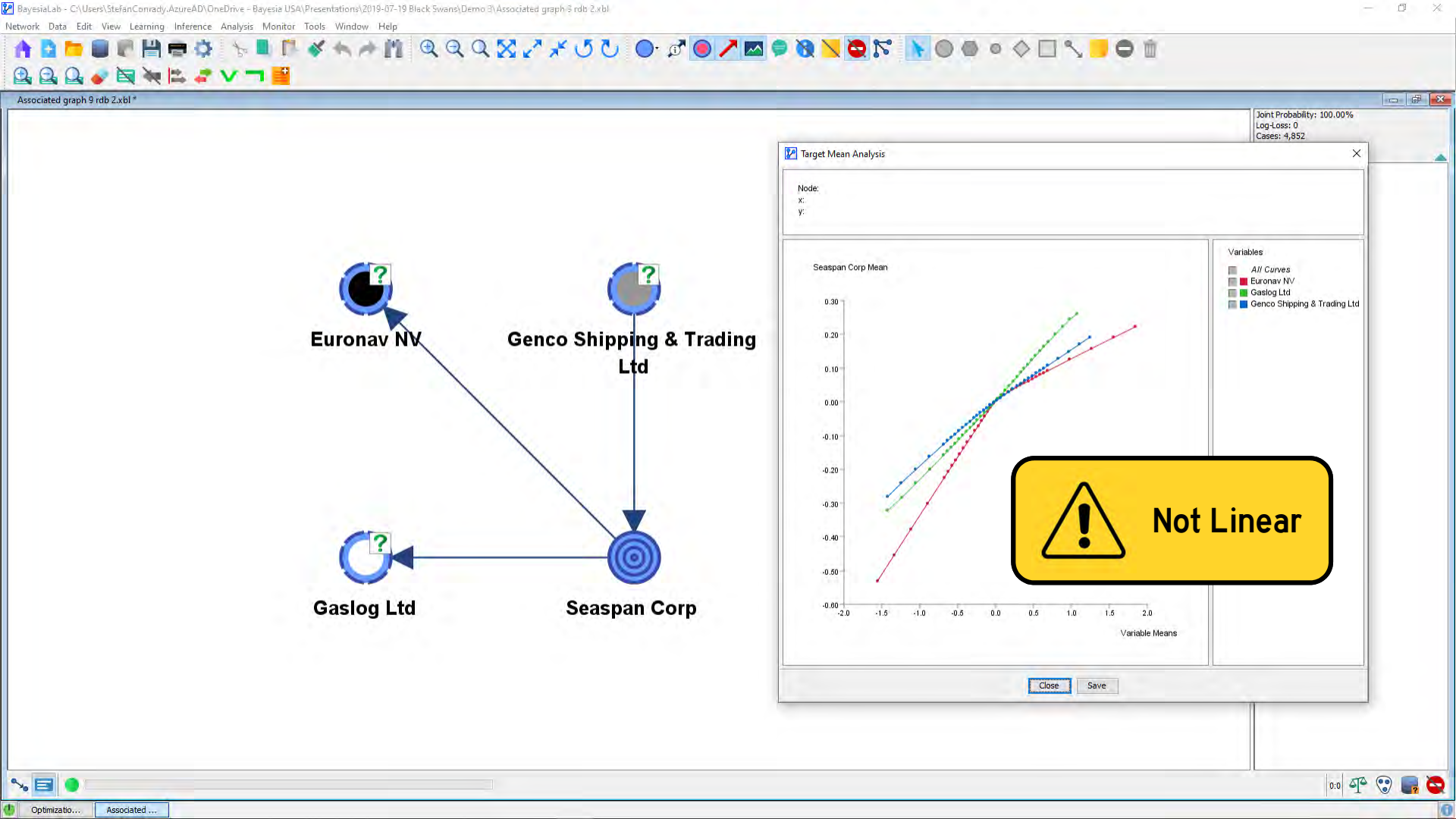
Unsupervised Learning

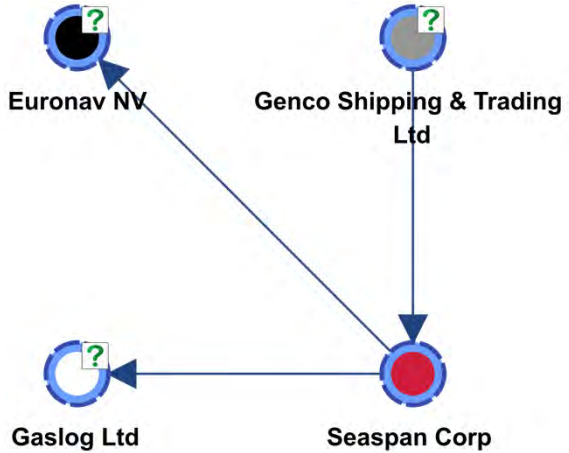


The network approximates the joint probability distribution of the historical data.


BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-19 Black Swans\Demo 3\Associated graph 9 rdb 2.xbl
Network Data Edit View Learning Inference Analysis Monitor Tools Window Help
Associated graph 9 rdb 2.xbl *
Joint Probability: 100.00%
Log-Loss: 0
Cases: 4,852
Euronav NV
Genco Shipping & Trading Ltd
Gaslog Ltd
Seaspan Corp
Target Mean Analysis
Node:
x:
y:
Seaspan Corp Mean
Variables
All Curves
Euronav NV
Gaslog Ltd
Genco Shipping & Trading Ltd
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
-0.60
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
Variable Means
Not Linear
Close
Save
Optimizatio...
Associated ...

BayesiaLab - New graph 3.xbl
Network Data Edit View Learning Inference Tools Window Help
New graph 3.xbl *

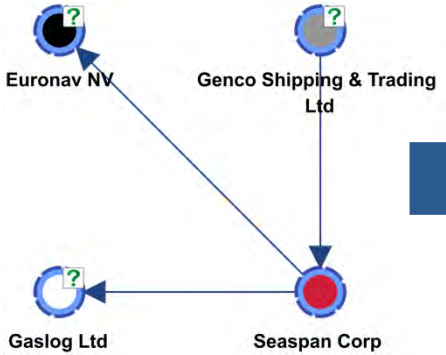
Objective: “mixing” the optimal portfolio — maximizing the expected return given a certain level of risk.

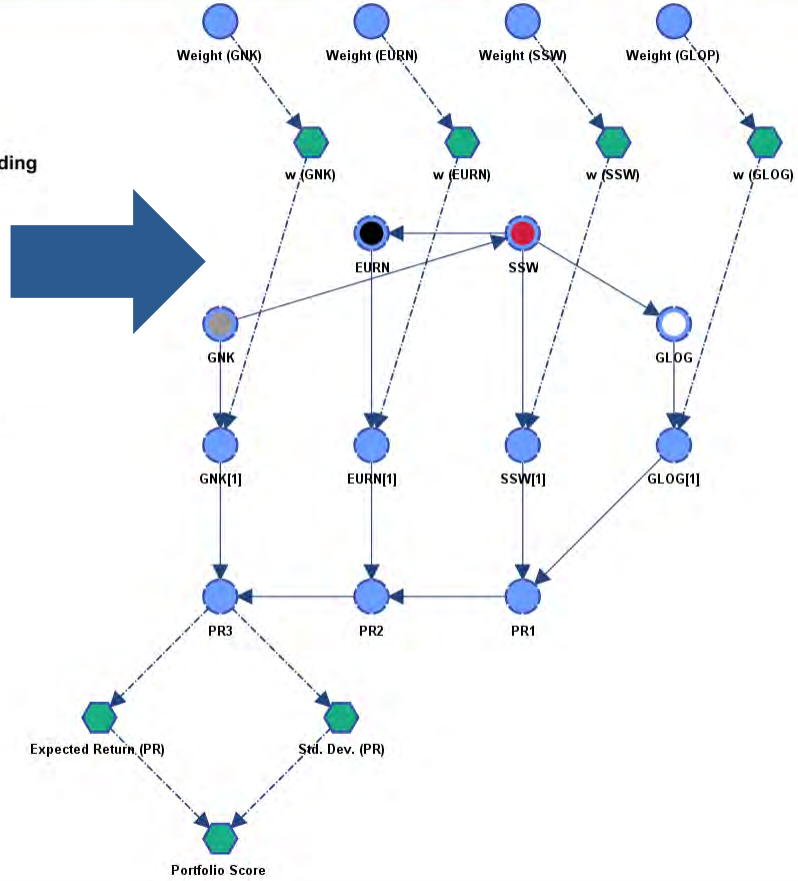


New graph ...

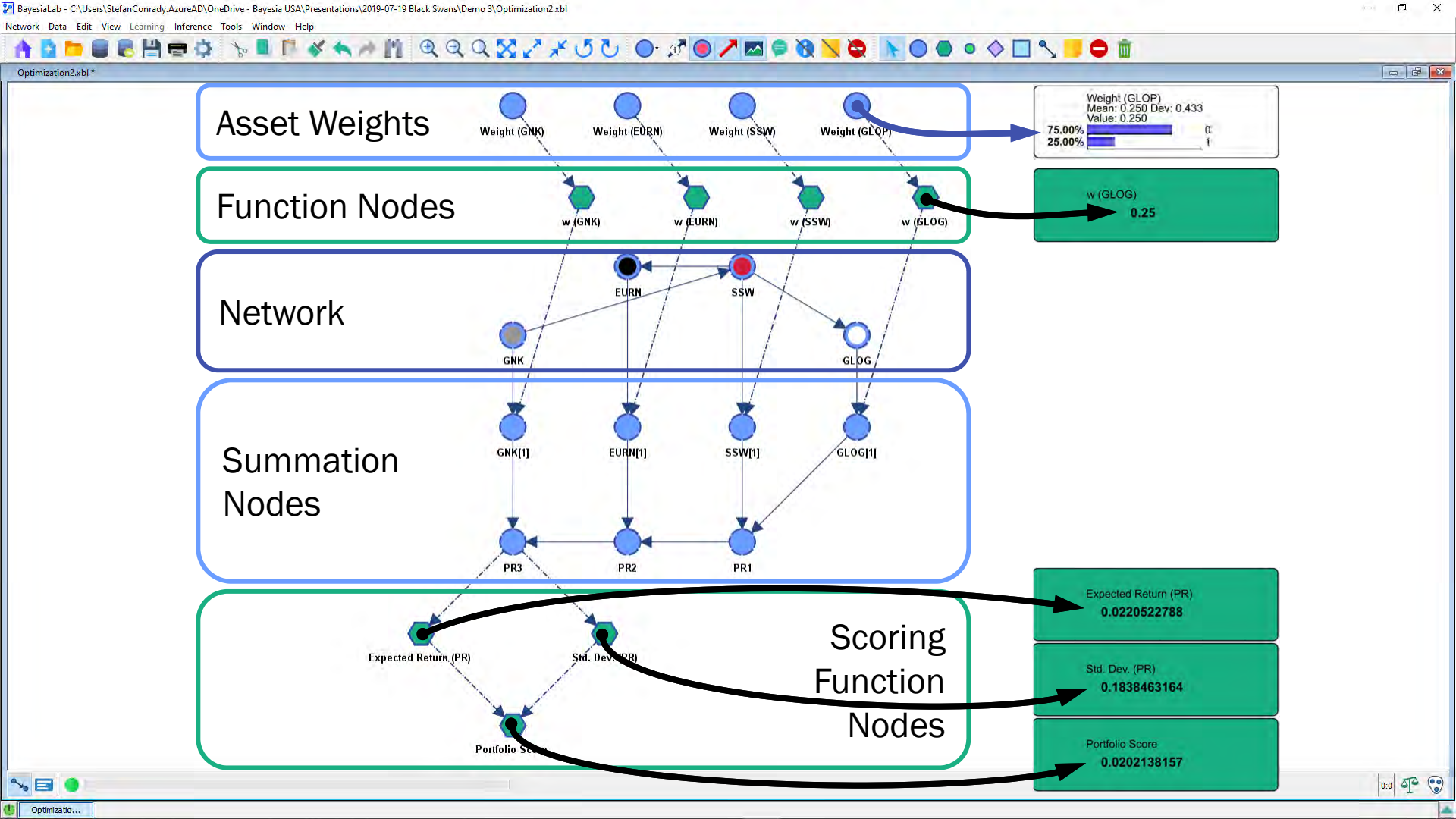
BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-19 Black Swans\Demo 3\Optimization2.xbl
Network Data Edit View Learning Inference Tools Window Help
Optimization2.xbl *

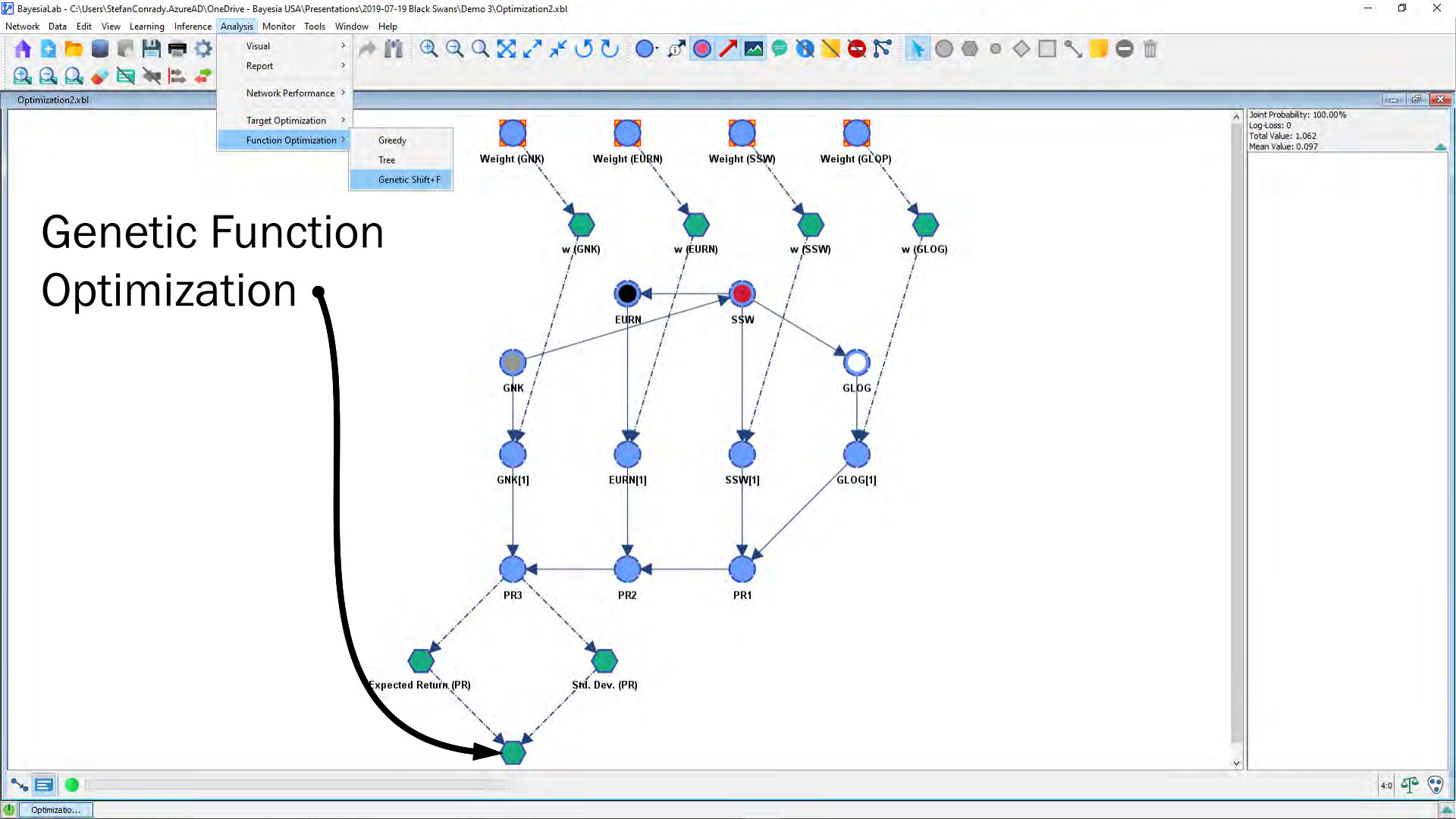
Optimization Framework

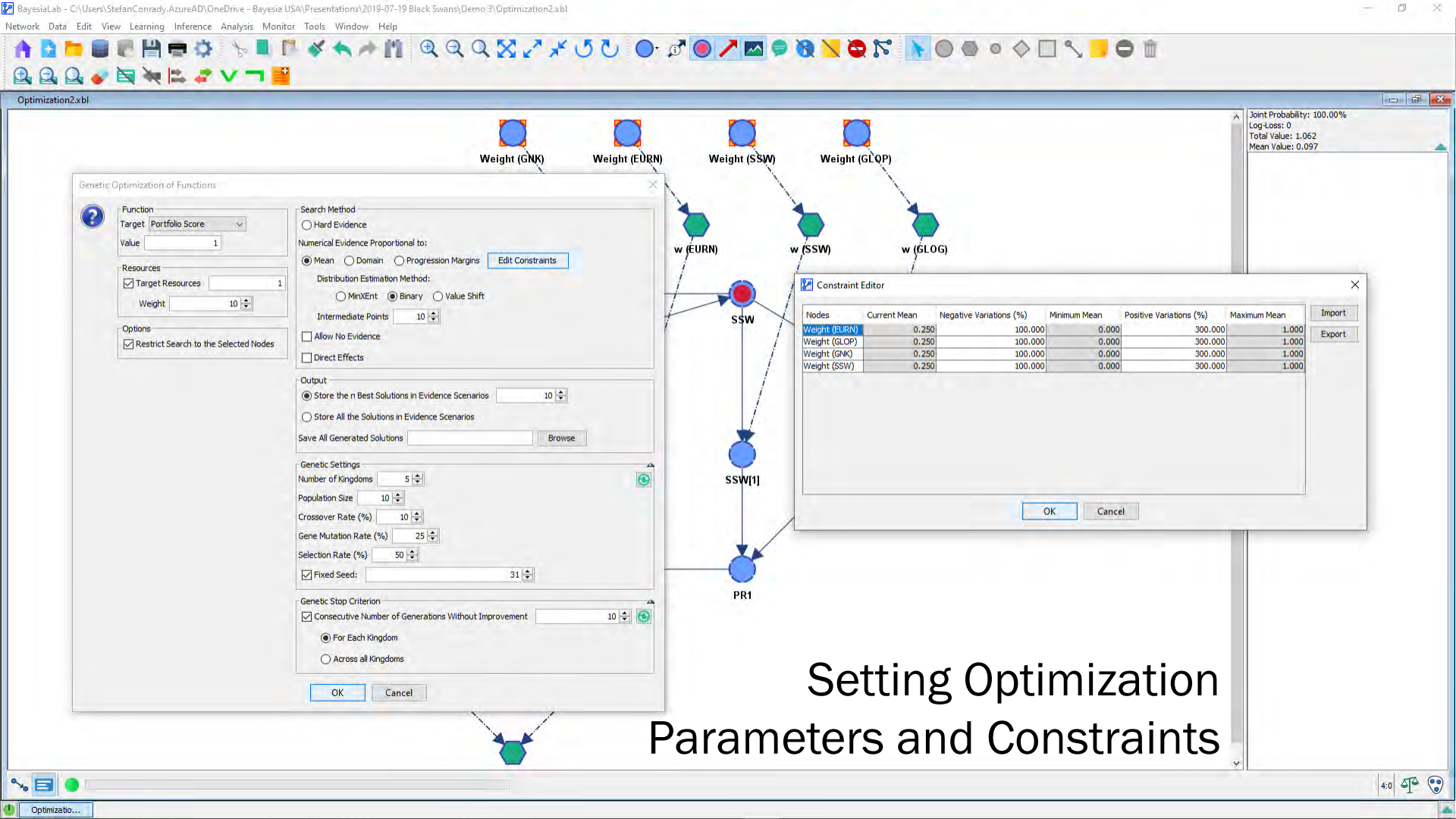




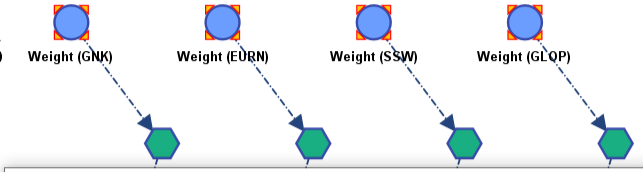
Optimizatio...


BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-19 Black Swans\Demo 3\Optimization2.xbl
Network Data Edit View Learning Inference Tools Window Help
Optimization2.xbl *
Asset Weights
Weight (GNK)
Weight (EURN)
Weight (SSW)
Weight (GLOP)
Weight (GLOP)
Mean: 0.250 Dev: 0.433
Value: 0.250
75.00% 0
25.00% 1
Function Nodes
w (GNK)
w (EURN)
w (SSW)
w (GLOG)
w (GLOG)
0.25
Network
EURN
SSW
GNK
GLOG
Summation Nodes
GNK[1]
EURN[1]
SSW[1]
GLOG[1]
PR3
PR2
PR1
Scoring Function Nodes
Expected Return (PR)
Std. Dev. (PR)
Portfolio Score
Expected Return (PR)
0.0220522788
Std. Dev. (PR)
0.1838463164
Portfolio Score
0.0202138157
Optimizatio...


BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-19 Black Swans\Demo 3\Optimization2.xbl
Network Data Edit View Learning Inference Analysis Monitor Tools Window Help
Visual
Report
Network Performance
Target Optimization
Function Optimization
Greedy
Tree
Genetic Shift+F
Optimization2.xbl
Genetic Function Optimization
Weight (GNK)
Weight (EURN)
Weight (SSW)
Weight (GLOP)
w (GNK)
w (EURN)
w (SSW)
w (GLOG)
EURN
SSW
GNK
GLOG
GNK[1]
EURN[1]
SSW[1]
GLOG[1]
PR3
PR2
PR1
Expected Return (PR)
Std. Dev. (PR)
Joint Probability: 100.00%
Log-Loss: 0
Total Value: 1.062
Mean Value: 0.097


BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-19 Black Swans\Demo 3\Optimization2.xbl
Network Data Edit View Learning Inference Analysis Monitor Tools Window Help
Optimization2.xbl
Weight (GNK)
Weight (EURN)
Weight (SSW)
Weight (GLOP)
w (EURN)
w (SSW)
w (GLOG)
SSW
SSW[1]
PR1
Joint Probability: 100.00%
Log-Loss: 0
Total Value: 1.062
Mean Value: 0.097
Genetic Optimization of Functions
Function
Target Portfolio Score
Value 1
Resources
Target Resources 1
Weight 10
Options
Restrict Search to the Selected Nodes
Search Method
Hard Evidence
Numerical Evidence Proportional to:
Mean Domain Progression Margins Edit Constraints
Distribution Estimation Method:
MinXEnt Binary Value Shift
Intermediate Points 10
Allow No Evidence
Direct Effects
Output
Store the n Best Solutions in Evidence Scenarios 10
Store All the Solutions in Evidence Scenarios
Save All Generated Solutions Browse
Genetic Settings
Number of Kingdoms 5
Population Size 10
Crossover Rate (%) 10
Gene Mutation Rate (%) 25
Selection Rate (%) 50
Fixed Seed: 31
Genetic Stop Criterion
Consecutive Number of Generations Without Improvement 10
For Each Kingdom
Across all Kingdoms
OK Cancel
Constraint Editor
Nodes Current Mean Negative Variations (%) Minimum Mean Positive Variations (%) Maximum Mean
Weight (EURN) 0.250 100.000 0.000 300.000 1.000
Weight (GLOP) 0.250 100.000 0.000 300.000 1.000
Weight (GNK) 0.250 100.000 0.000 300.000 1.000
Weight (SSW) 0.250 100.000 0.000 300.000 1.000
Import
Export
OK Cancel
Setting Optimization
Parameters and Constraints

Optimization Results



Optimization Report of Portfolio Score (Optimization2)

Analysis Context
No Observation

Initial State	
Value	Resources
0.0202	1.0000

Search Method: Numerical Evidence Proportional to: Mean - Fix Probabilities (Binary)

Synthesis				
Nodes	Weight (EURN)	Weight (GLOP)	Weight (GNK)	Weight (SSW)
Initial State	0.2500	0.2500	0.2500	0.2500
Best Solution	0.1818 (-0.0682)	0.0909 (-0.1591)	0.6364 (0.3864)	0.0909 (-0.1591)
Min	0.0000 (-0.2500)	0.0000 (-0.2500)	0.0000 (-0.2500)	0.0909 (-0.1591)
Max	0.7273 (0.4773)	0.7273 (0.4773)	0.6364 (0.3864)	0.2727 (0.0227)

Best Solutions						
Weight (EURN)	Weight (GLOP)	Weight (GNK)	Weight (SSW)	Score	Value	Resources
0.1818	0.0909	0.6364	0.0909	0.9717	0.0283 (0.0081)	1.0000 (0.0000)
0.7273	0.0000	0.1818	0.0909	0.9973	0.0027 (-0.0175)	1.0000 (0.0000)
0.0000	0.7273	0.0000	0.2727	1.0348	-0.0348 (-0.0550)	1.0000 (0.0000)
0.1818	0.7273	0.0000	0.1818	1.9126	-0.0035 (-0.0237)	1.0909 (0.0909)

Close | Save As... | Print

Best Solutions

Joint Probability: 100.00%
Log-Loss: 0
Total Value: 1.062
Mean Value: 0.097

```
Console :
9:      [1.1998799] [1.1998799] [1.1998799] [1.1998799] [1.1998799]
0:      [1.9125873] [1.9125873] [1.9125873] [1.9125873] [1.9125873]
1:      [1.905823] [1.9125873] [1.9125873] [1.9125873] ***[1.0348168]***
2:      ***[0.9972874]*** [0.9989265] [1.9125873] [1.9053544] [1.0348168]
3:      [0.9972874] [0.9989265] [1.9125873] [1.8790834] [1.0348168]
4:      [0.9972874] [0.9989265] [1.9125873] [1.0000464] [1.0348168]
5:      [0.9972874] [0.9989265] [1.0050947] [1.0000464] [1.0331002]
6:      [0.9972874] [0.9972874] [1.0050947] ***[0.9717083]*** [1.0331002]
7:      [0.9717083] [0.9972874] [0.9989265] [0.9717083] [1.0331002]
8:      [0.9717083] [0.9972874] [0.9989265] [0.9717083] [1.0331002]
9:      [0.9717083] [0.9972874] [0.9989265] [0.9717083] [0.9717083]
10:     [0.9717083] [0.9972874] [0.9717083] [0.9717083] [0.9717083]
```

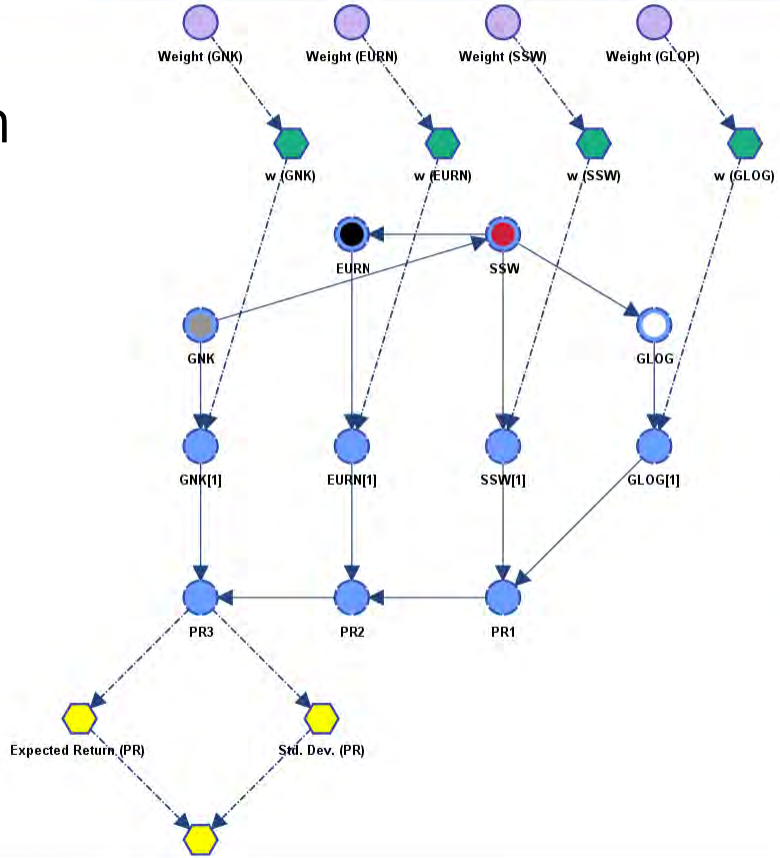
Solution Progress

BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-19 Black Swans\Demo 3\Optimization2.xbl

Network Data Edit View Learning Inference Analysis Monitor Tools Window Help

Optimization2.xbl *

Best Solution



Joint Probability: 24.51%
Log-Loss: 2.03
Total Value: -1.392
Mean Value: -0.116

Weight (GNK)
Mean: 0.636 Dev: 0.481
Value: 0.636 (+0.386)
36.36% 0
63.64% 1

Weight (EURN)
Mean: 0.182 Dev: 0.386
Value: 0.182 (-0.068)
81.82% 0
18.18% 1

Weight (SSW)
Mean: 0.091 Dev: 0.287
Value: 0.091 (-0.159)
90.91% 0
9.09% 1

Weight (GLOP)
Mean: 0.091 Dev: 0.287
Value: 0.091 (-0.159)
90.91% 0
9.09% 1

Expected Return (PR)
0.0311092302
(0.0220522788)

Std. Dev. (PR)
0.281755068
(0.183846316)

Portfolio Score
0.0282916795
(0.0200213815)

Best Solution

Select an evidence set

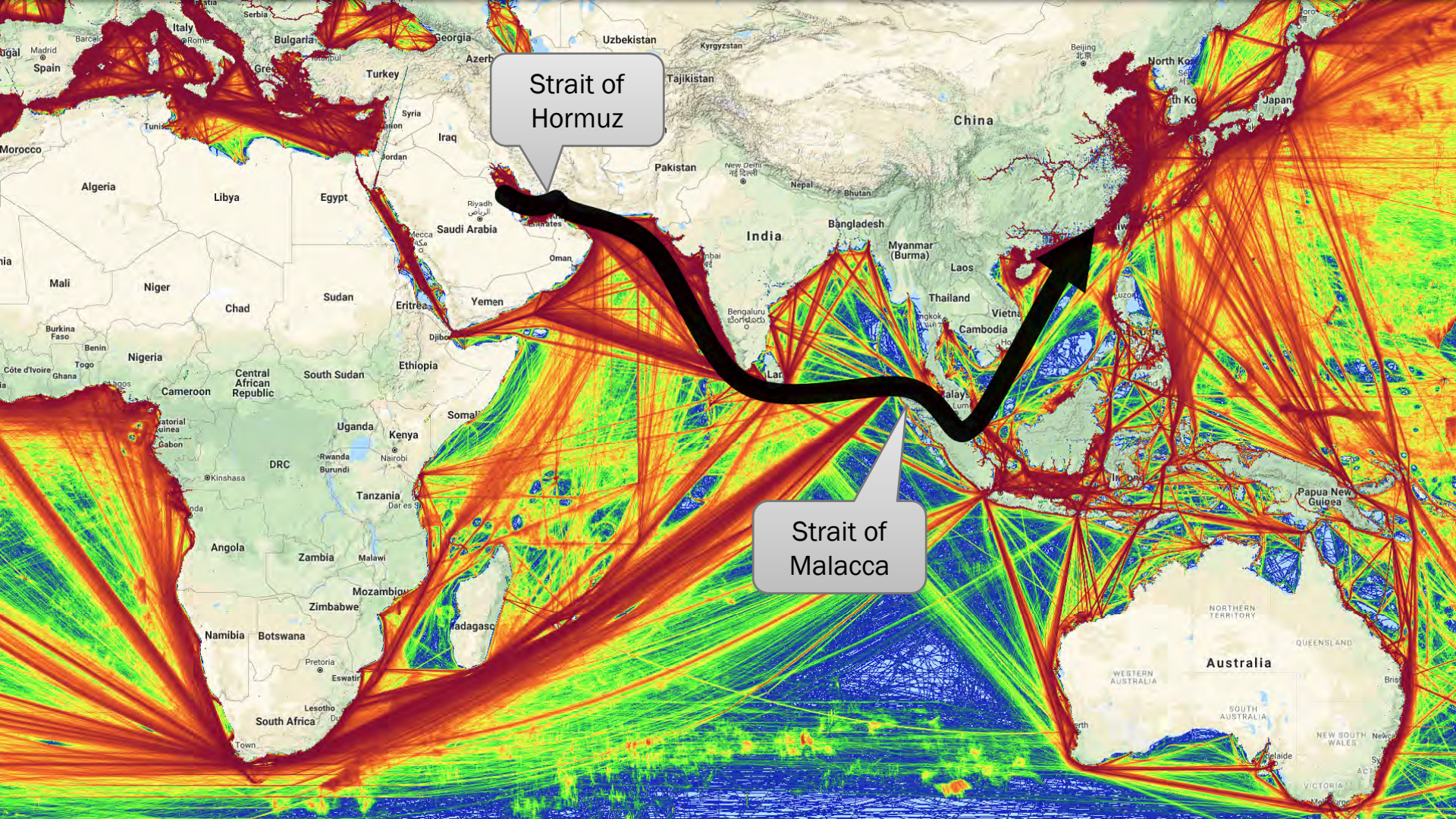
Index	Comment
0	GA Score: 0.9717083
1	GA Score: 0.9972874
2	GA Score: 1.0348168
3	GA Score: 1.9125873

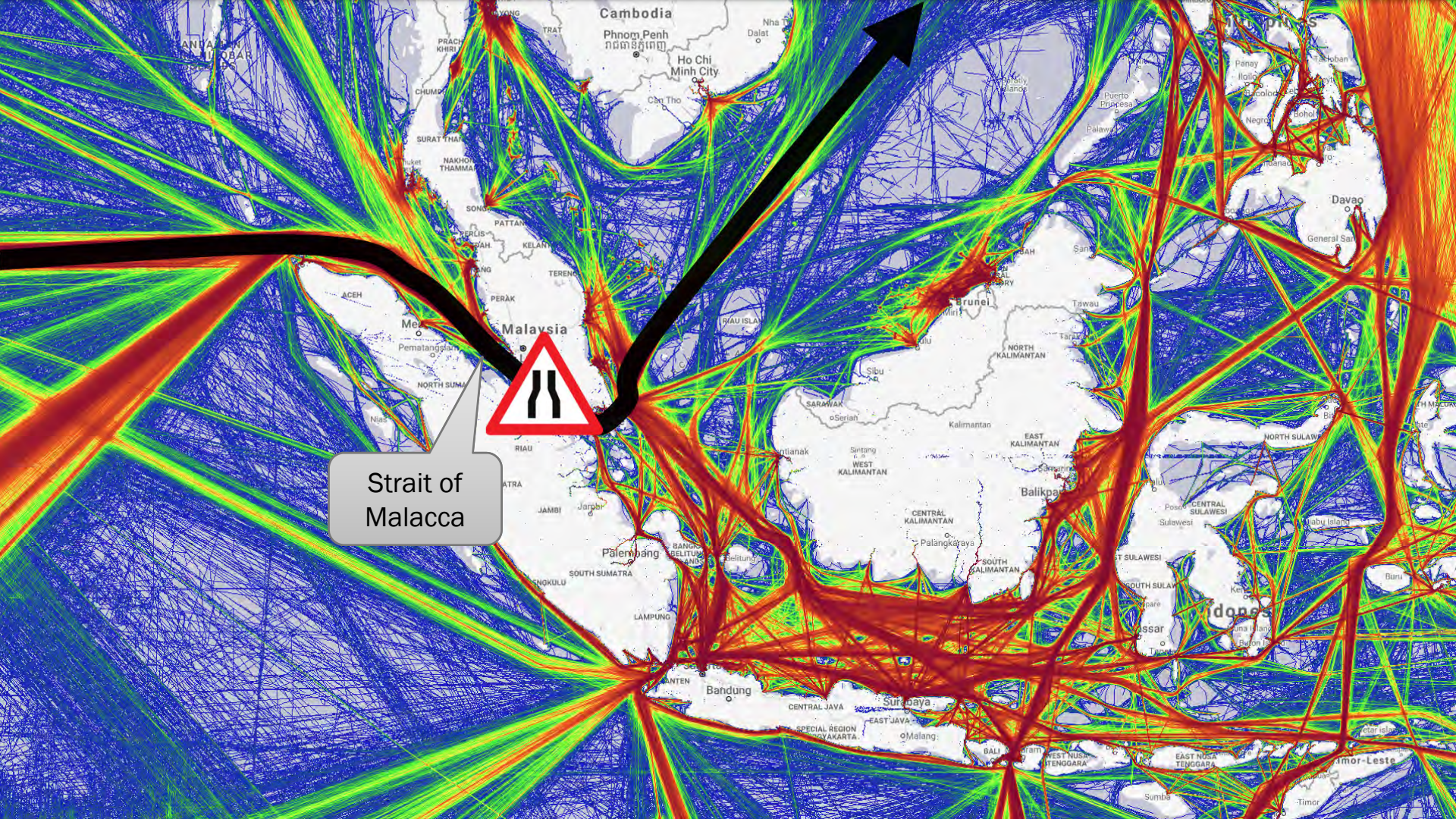
4 Rows Include Not Observable

GA Score: 0.9717083

Optimizatio...

THAT WAS JUST BUSINESS AS USUAL…


Strait of Hormuz
Strait of Malacca
Italy
Bulgaria
Georgia
Uzbekistan
Kyrgyzstan
Tajikistan
Turkey
Syria
Iraq
Jordan
Pakistan
China
Japan
Morocco
Algeria
Libya
Egypt
Saudi Arabia
Oman
India
Bangladesh
Nepal
Bhutan
Myanmar (Burma)
Laos
Thailand
Cambodia
Mali
Niger
Chad
Sudan
Eritrea
Yemen
Nigeria
Cameroon
Central African Republic
South Sudan
Ethiopia
Uganda
Kenya
DRC
Tanzania
Angola
Zambia
Malawi
Zimbabwe
Namibia
Botswana
South Africa
Papua New Guinea
Australia
NORTHERN TERRITORY
QUEENSLAND
WESTERN AUSTRALIA
SOUTH AUSTRALIA
NEW SOUTH WALES
VICTORIA

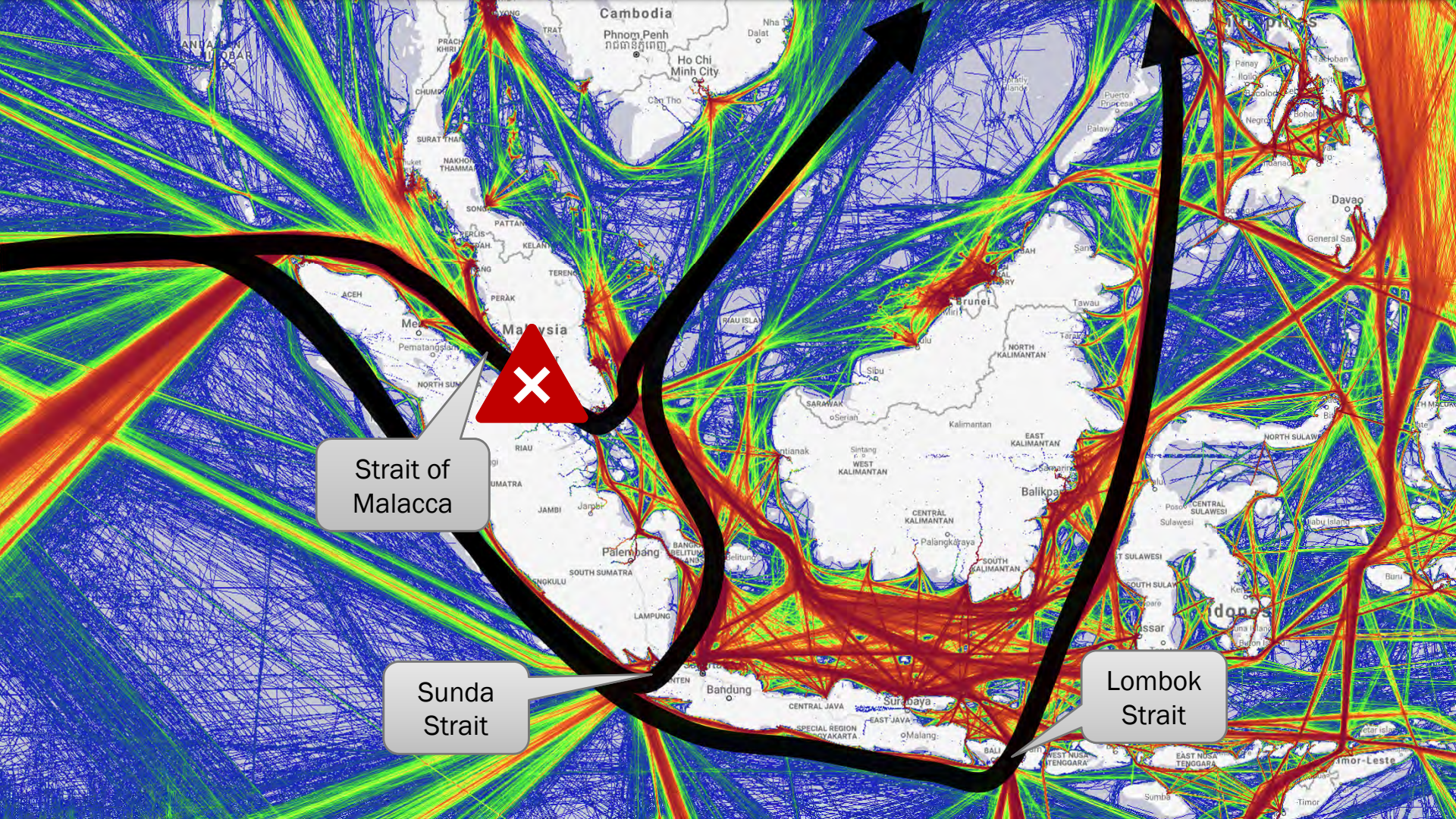

Strait of Malacca
Cambodia
Phnom Penh
Ho Chi Minh City
Malaysia
Brunei
Palembang
Bandung
Surabaya
Davao

Hypothetical Event

NAVY BLOCKADE OF MALACCA STRAIT

Hypothetical Event

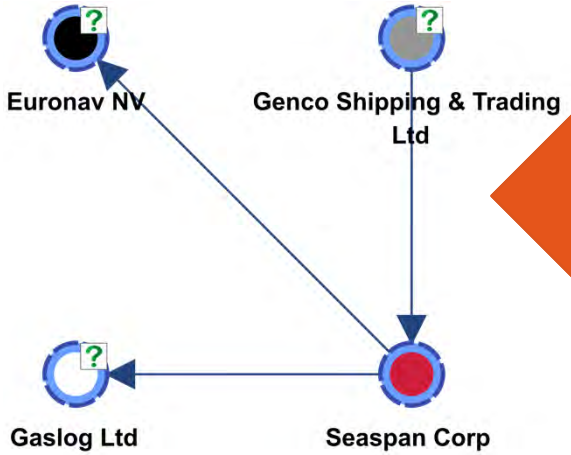
NUCLEAR SUBMARINE DISASTER
IN MALACCA STRAIT


Strait of Malacca
Sunda Strait
Lombok Strait

Impact on Stock Market

Black Swan Scenarios

- Any such risks are obviously not reflected in the Bayesian network that we used to optimize our investment portfolio.
- So, how can we account for such risks?



Theoretical Considerations

Modern Portfolio Theory

Criticism

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- Variance is a symmetric measure, but risk is not symmetric, i.e., only “downside” is risk; “upside” is opportunity.
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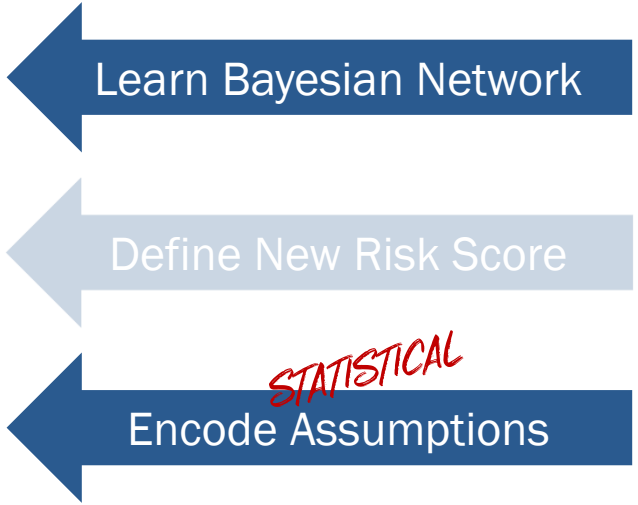
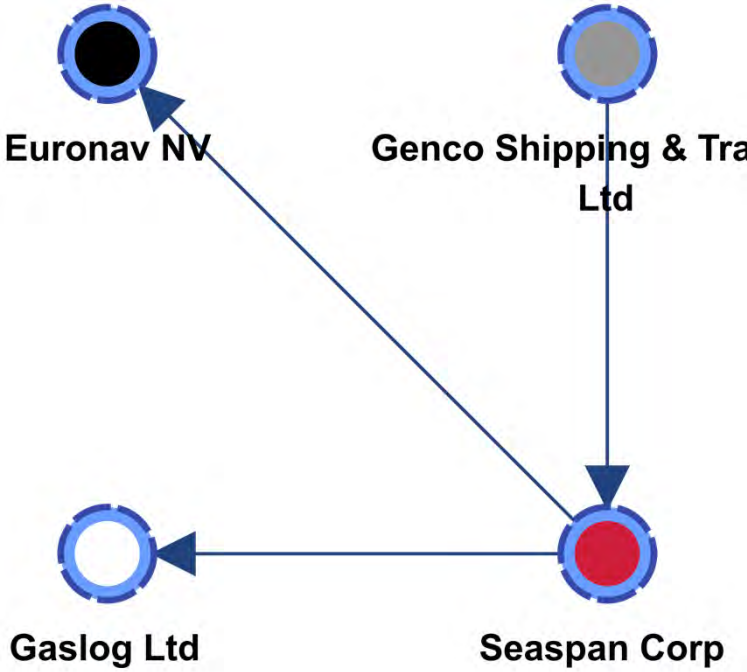
Countermeasures



Black Swan Scenarios

Potential Impact on Stock Portfolio

- We need to modify the joint probability distribution so that it reflects our estimates of the extreme event.



Black Swan Scenarios

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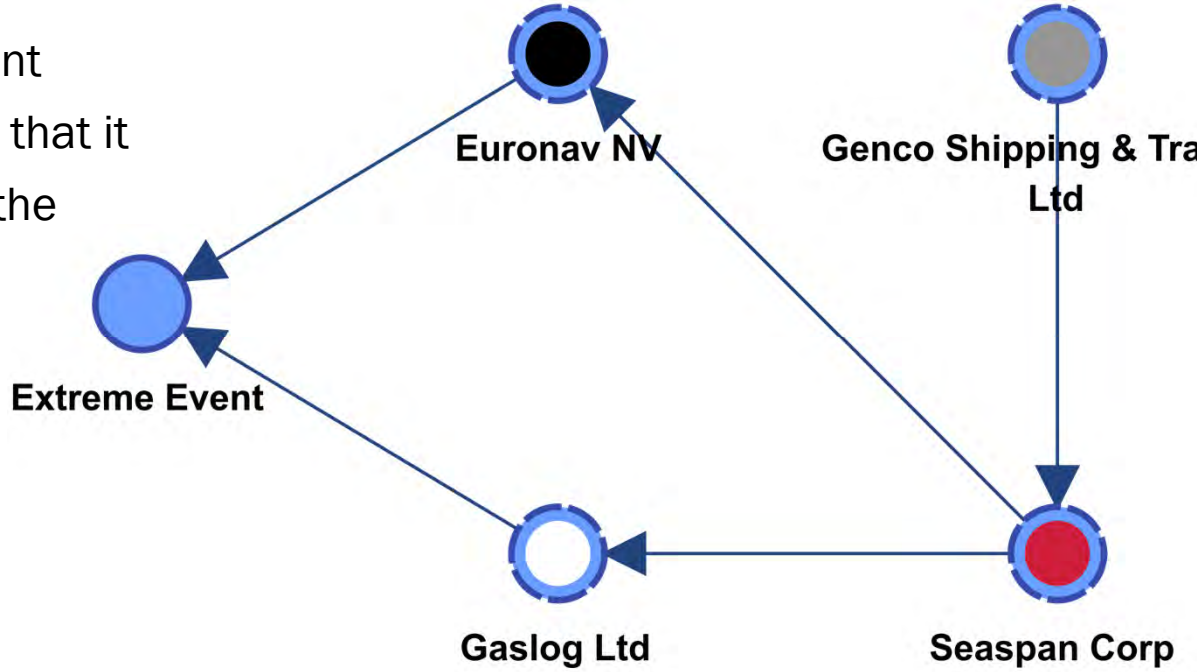
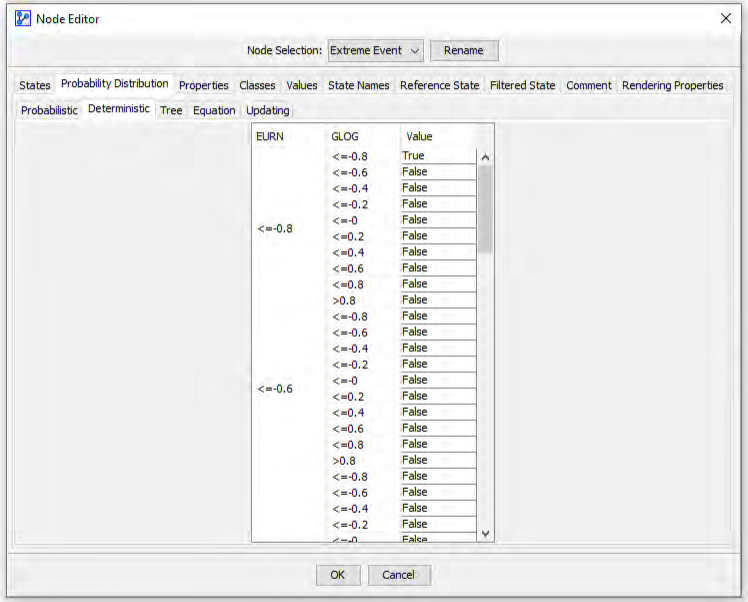
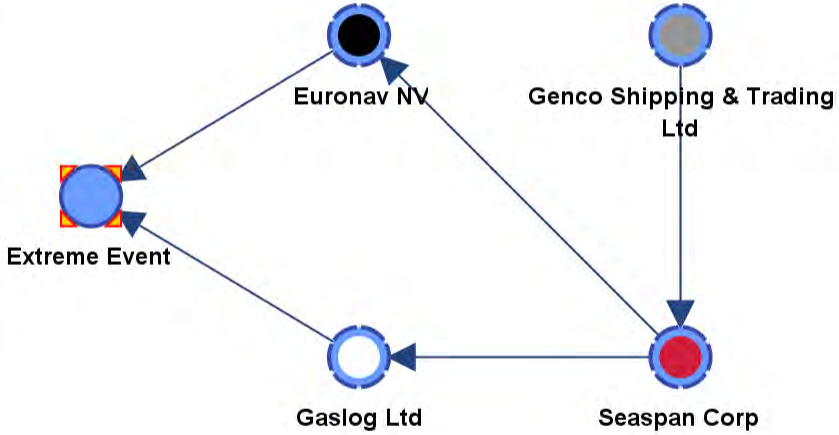


Encoding Assumptions





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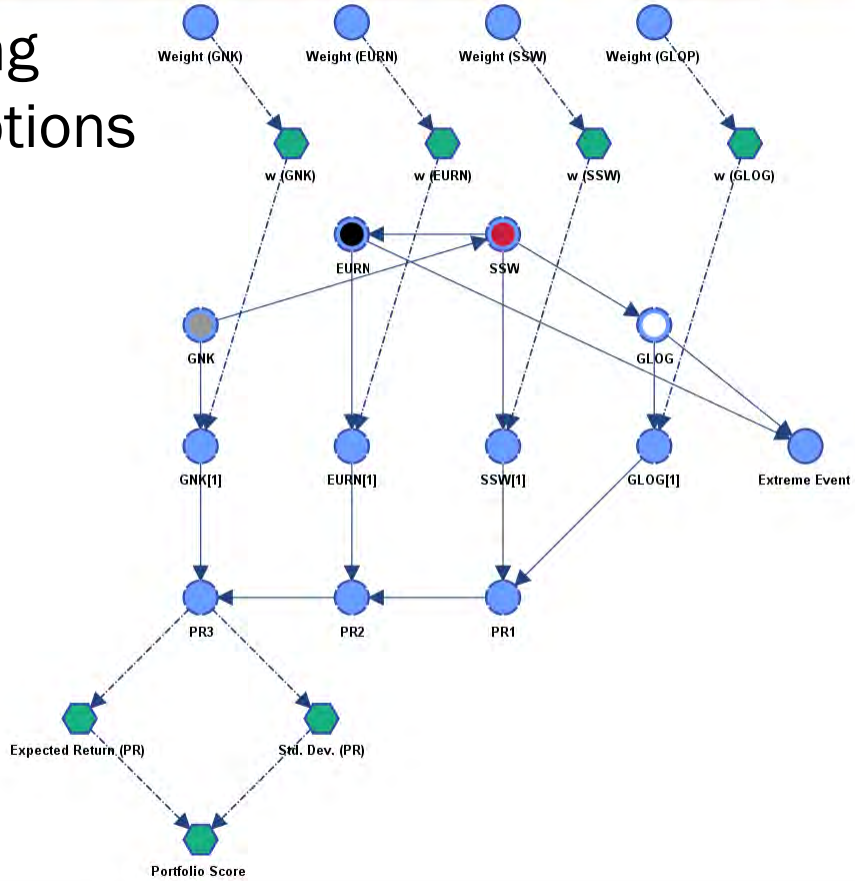

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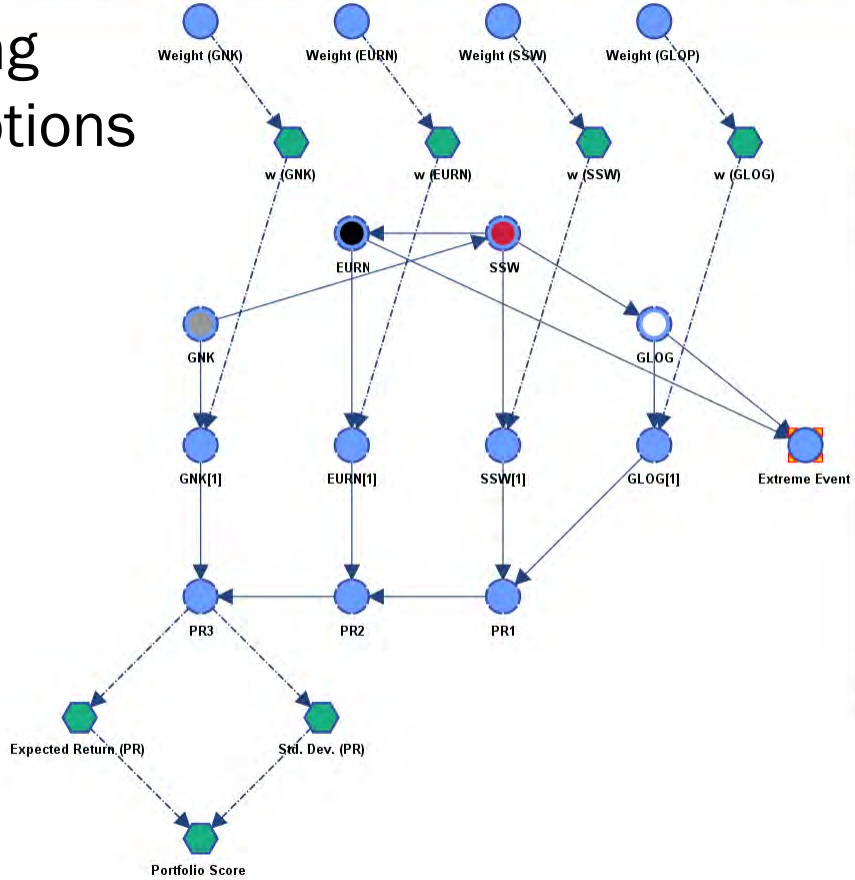

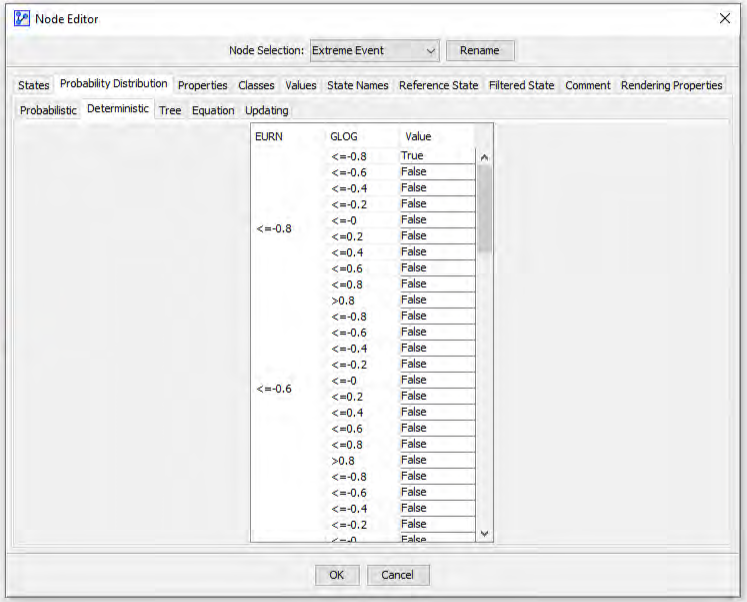

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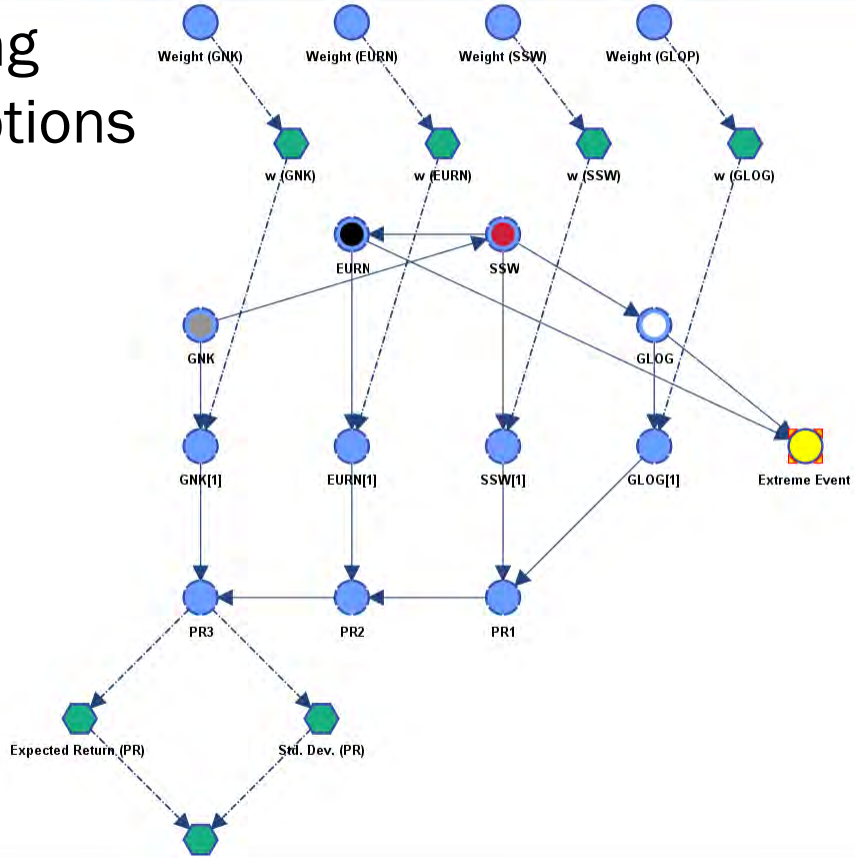
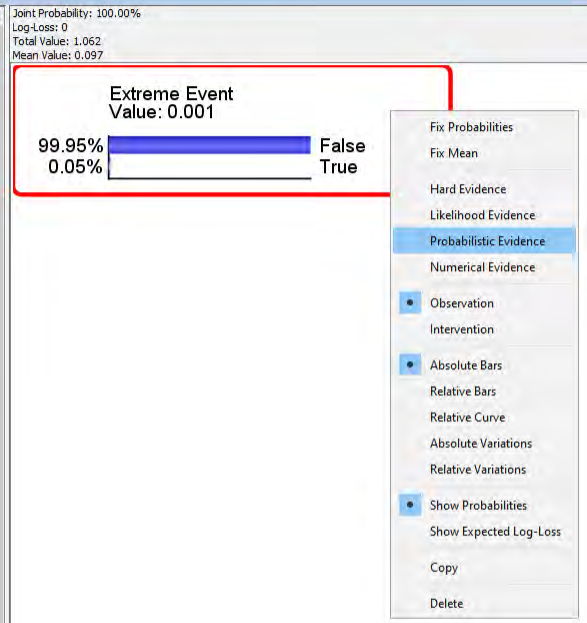
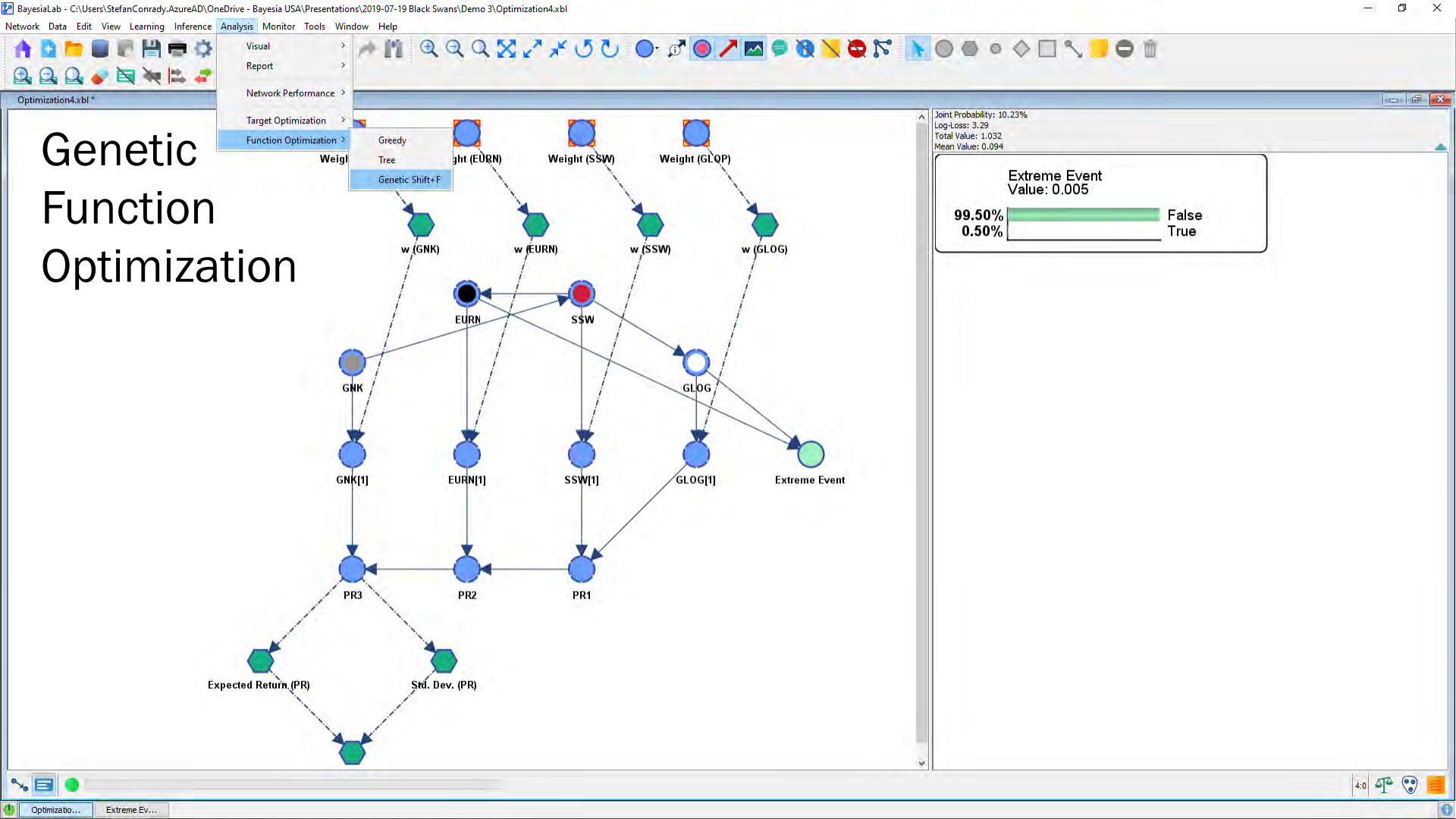
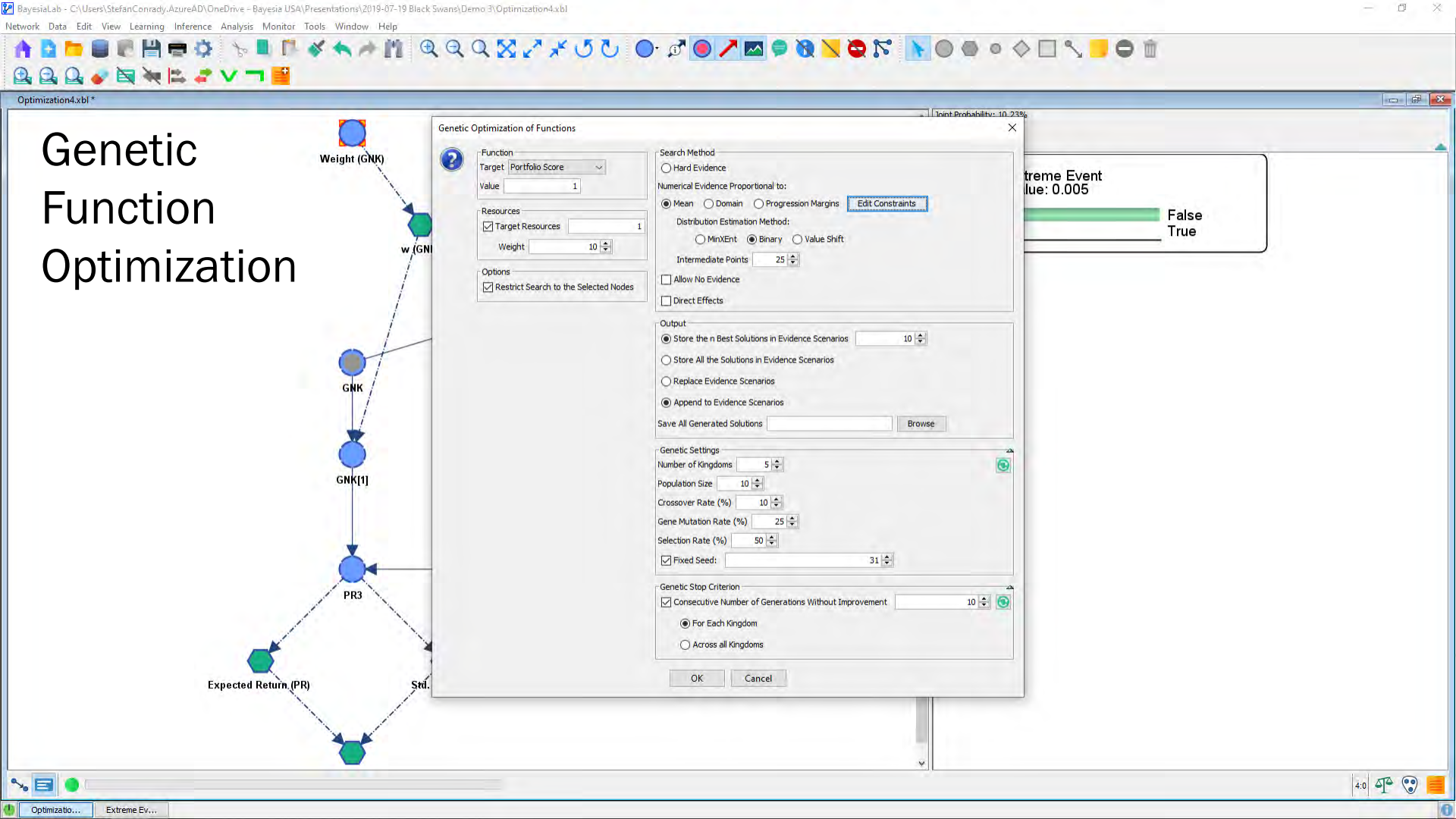




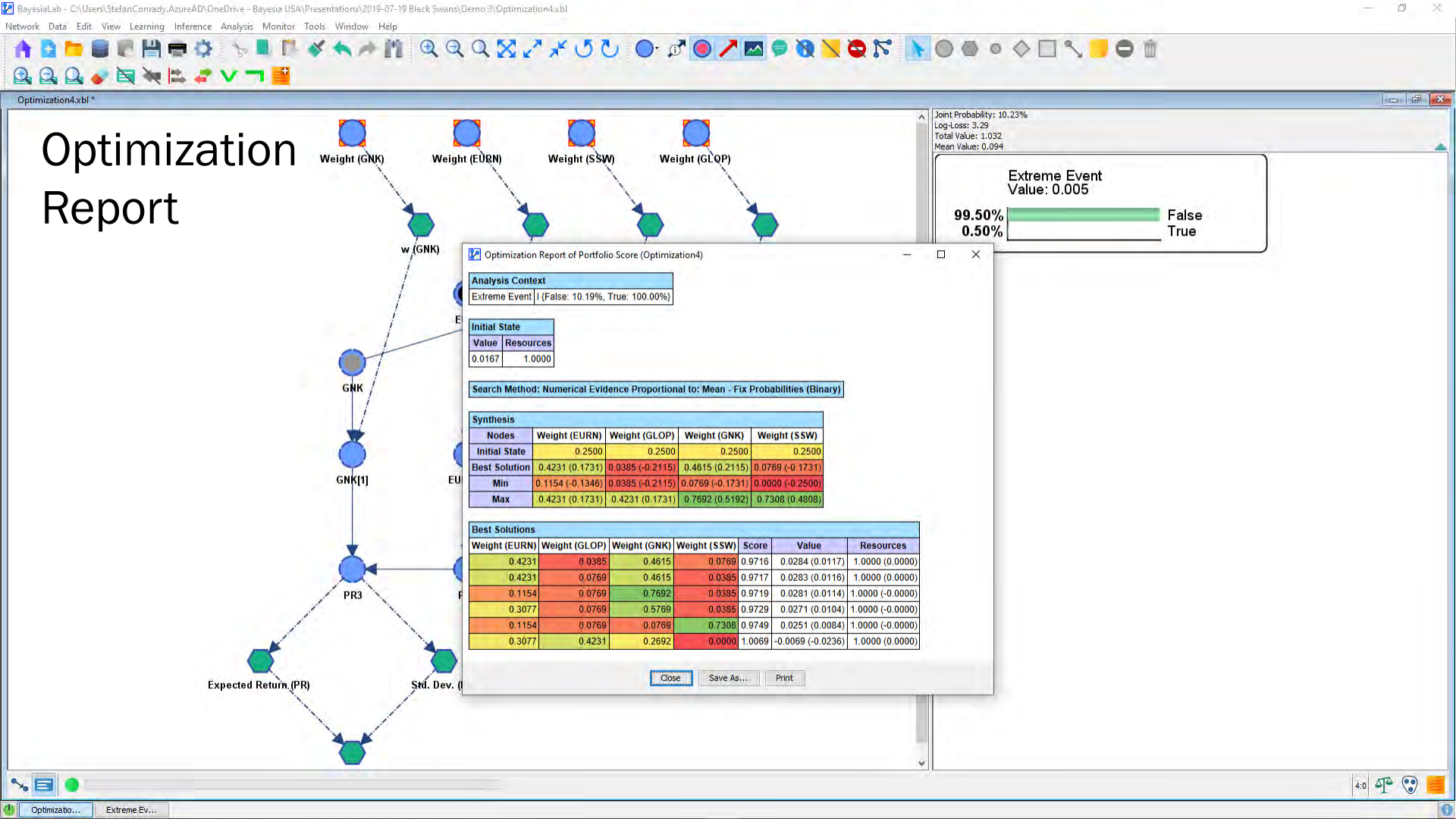
Genetic Function Optimization



Genetic Function Optimization



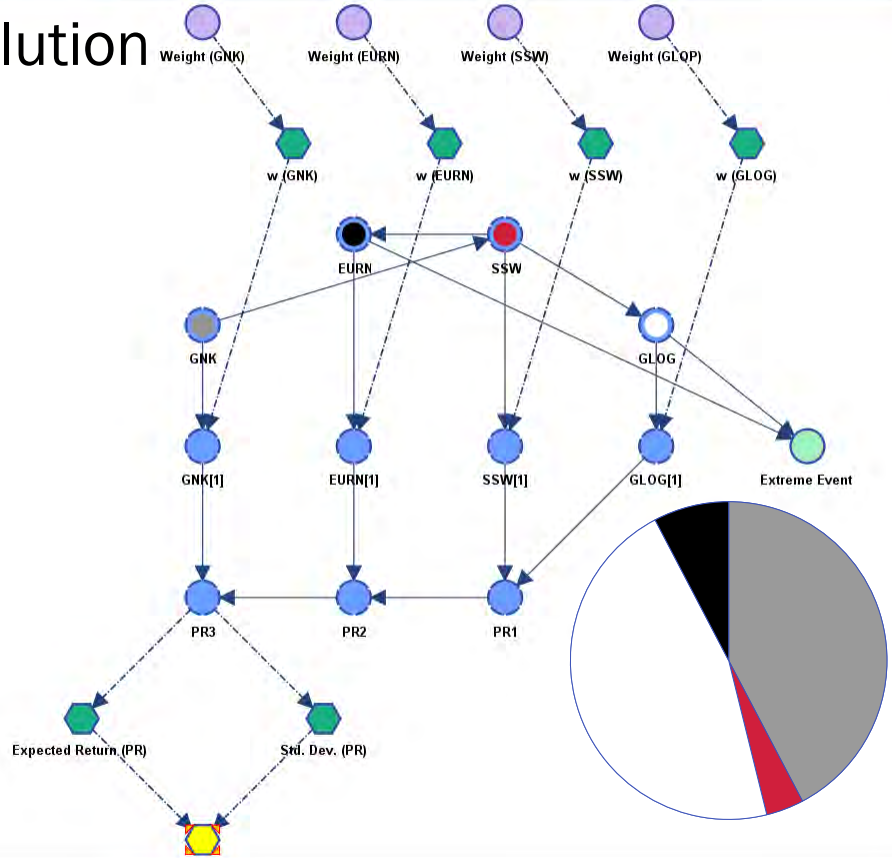
Optimization Report



BayesiaLab - C:\Users\StefanConrady.AzureAD\OneDrive - Bayesia USA\Presentations\2019-07-19 Black Swans\Demo 3\Optimization4.xbl
Network Data Edit View Learning Inference Analysis Monitor Tools Window Help

Optimization4.xbl *

Best Solution



Joint Probability: 2.08%
Log-Loss: 5.59
Total Value: 1.051
Mean Value: 0.096

Extreme Event
Value: 0.005

99.50%	False
0.50%	True

Weight (GNK)
Mean: 0.462 Dev: 0.499
Value: 0.462

53.85%	0
46.15%	1

Weight (EURN)
Mean: 0.423 Dev: 0.494
Value: 0.423

57.69%	0
42.31%	1

Weight (SSW)
Mean: 0.077 Dev: 0.266
Value: 0.077

92.31%	0
7.69%	1

Weight (GLOP)
Mean: 0.038 Dev: 0.192
Value: 0.038

96.15%	0
3.85%	1

Portfolio Score
0.0283754499
(0.0202138157)

GA Score: 0.9716246

Optimizatio... Extreme Ev...

Thank You!

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BayesianNetwork

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