Double Exponential Jump Diffusion (DEJD) Validation Report - New Variation (DEX 600 & 1500)

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Product Information

Product Specification : https://docs.google.com/document/d/1PO6DN2w2AkK-d8faAwmFWDkJu02LLgsF/edit

Perl Code (8 Aug 2023): https://github.com/regentmarkets/perl-Feed-Index-JumpDiffusion/tree/b37fe3cf4b62104c5af82fb020bcd3f6d05f32c2

Background & Introduction

There were 2 variations of Double Exponential Jump Diffusion (DEJD) indices launched on May 2023, which are DEX D900 and DEX U900.

In this time, another 4 variations are suggested to be part of the DEJD family, for the purpose of diversifying the concentration risk on a particular index, especially either on DOWN or UP.

The product description and the construction are exactly the same, except the parameters for these 4 variations are set differently.

For information about the index construction, please refer to the Double Exponential Jump Diffusion (DEJD) Index Validation Report as of 22 May 2023 (link here/Dex%20Indices%20Validation%20Report.pdf)).

The parameters are:

New/Old	Index	Number of Jumps per Hour λ	Average Positive Jump Size η_+	Average Negative Jump Size η_-	Probability of Positive Jump q_+	Probability of Negative Jump q_-	Volatility
Old	DEX U900	20, which is 175200 per year	0.30%	0.04%	20%	80%	25%
Old	DEX D900	20, which is 175200 per year	0.04%	0.30%	80%	20%	25%

New	DEX U600	30, which is 262800 per year	0.20%	0.04%	20%	80%	20%
New	DEX D600	30, which is 262800 per year	0.04%	0.20%	80%	20%	20%
New	DEX U1500	6, which is 52560 per year	0.20%	0.04%	40%	60%	10%
New	DEX D1500	6, which is 52560 per year	0.04%	0.20%	60%	40%	10%

Model Validation

Summary

For the validation of the new 4 variations of DEX indices, we cover the below areas and conclude the outcomes. 2 old variations are included as well for comparison.

Note that this validation covers the data from 8 August 2023 to 27 August 2023.

More details can be found in respective section.

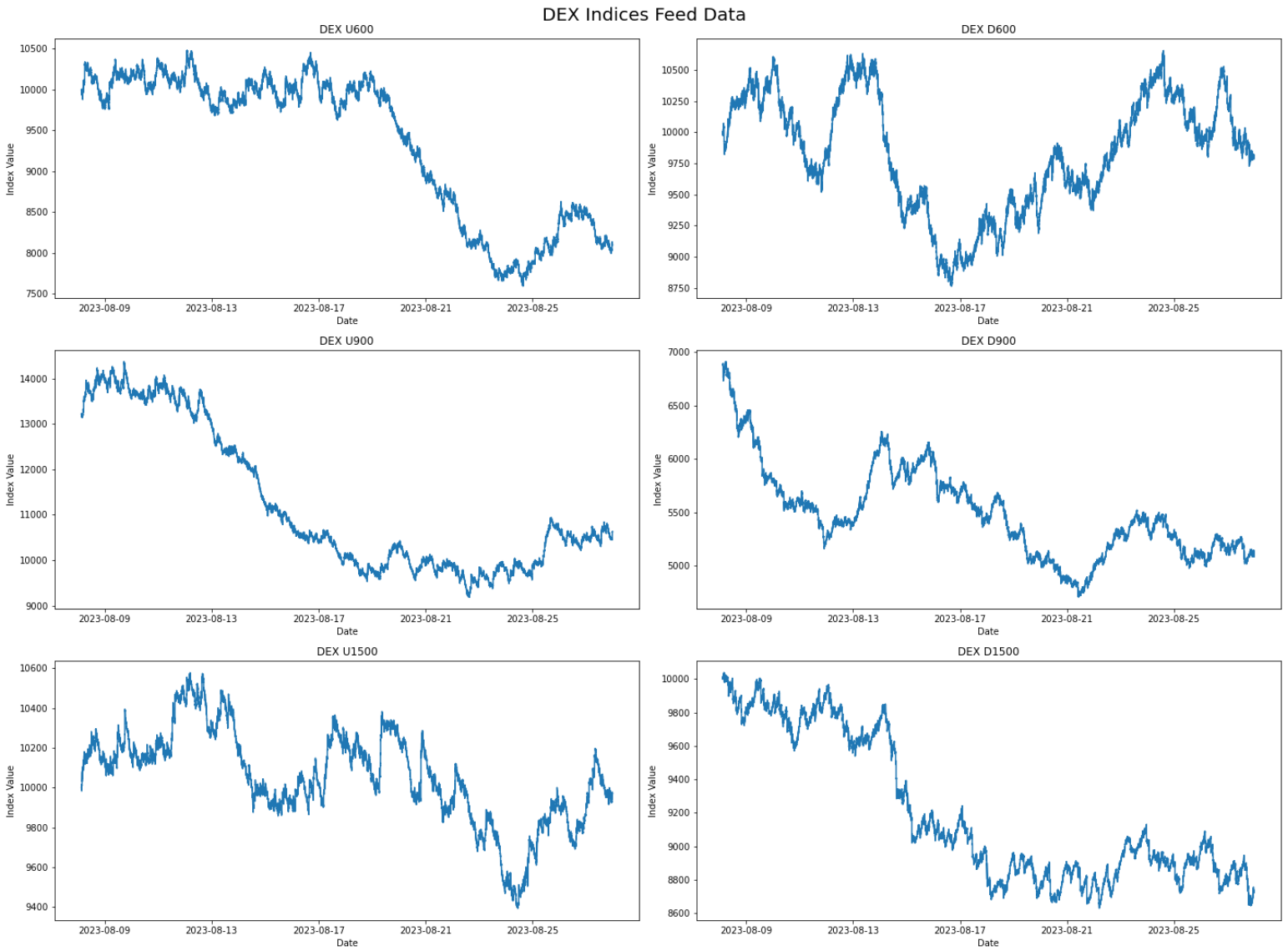
Section	Area	Validation	Outcome	Pass/Fail
1	Check the moment of the feed data	We compute the moment of the feed data, and check whether it is matching with the true distribution.	We checked the moments of the feed data vs simulation for 3 sets of data, Dev data only, Demo data only and Dev + Demo data. The moments are matching.	**Passed**
2	Backward engineering the parameters.	Here we check the parameters backward engineering from the feed data moment. We do not proceed with the MLE method as the implementation is very difficult to implement	The result looks fine with the set initial condition and boundary condition.	**Passed**
3	Convergence of the feed data moment	The convergence speed of the first 3 moments are checked.	Generally the first moment and second moment converge to the true value fast, the skewness converges slower but within acceptable range. The result is fine.	**Passed**
4	Concentration Risk Stress Testing	Few strategy testings on simulation data is run to ensure that there is no potential exploitation and the reasonableness of the spread.	The strategy testing does not discover any potential exploitation. The strategy testing result also shows that the spread of the new 4 variations can be as low as 50% of DEX 900. While the spread of DEX 900 is set at around 0.01% of the index value, the spread of DEX 600/1500 is set at 0.0075% is reasonable.	**Passed**
5	Correlation between variations	This is to test the correlation between UP indices and DOWN indices, which should be almost zero	Correlations between tickly data and hourly data do not appear high correlation.	**Passed**

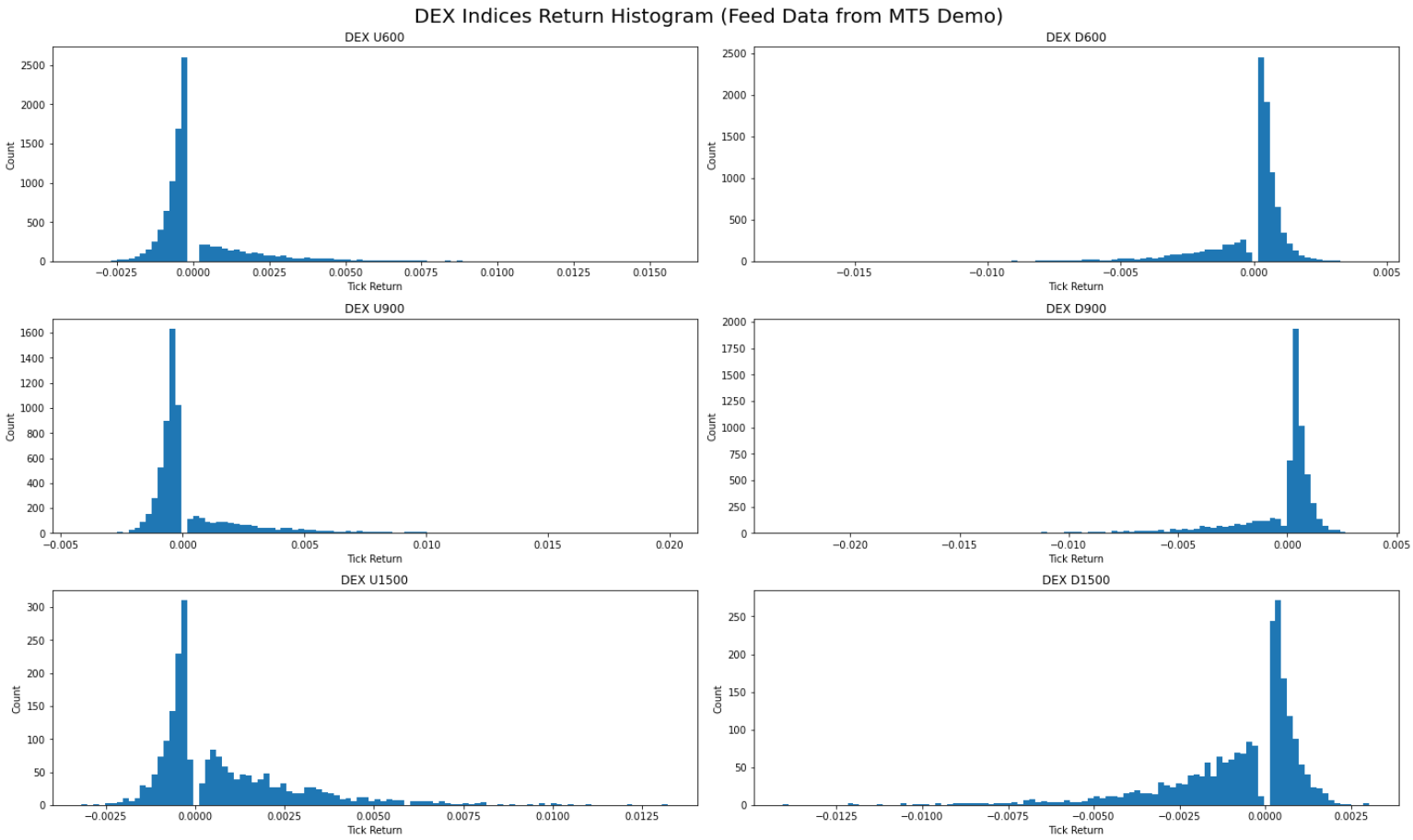
Section 1

In here we are checking the moments of the real feed data. The validation steps are: 1) Obtain the feed data from Metabase. 2) Compute the feed data moments (Mean, Volatility, Skewness & Kurtosis). 3) Run the simulation and

compute the moments. 4) Compare (2) & (3)

Conclusion: 1) Mean - Acceptable as the abs difference is low. 2) Volatility - Acceptable as both abs and rel difference are low. 3) Skewness - Acceptable as rel difference is low. 4) Kurtosis - Acceptable.





Moment Matching on Demo Data only

Feed Data Moments (Demo Data Only)

	Mean	Volatility	Skewness	Kurtosis
DEX U600	-0.00000023	0.7170031	35.31630485	2274.90286739
DEX U900	-0.0	0.84538755	45.34611457	3078.70298327
DEX U1500	-0.00000003	0.41067984	61.2558964	5526.80111483
DEX D600	0.00000009	0.73754885	-37.32891679	2531.47848478
DEX D900	-0.00000011	0.88492772	-50.08588895	3986.17025176
DEX D1500	-0.00000004	0.43067356	-64.56591485	6360.34516846

True Moments

	Mean	Volatility	Skewness	Kurtosis
DEX U600	-0.00000001	0.72646872	35.77045777	2299.83214784
DEX U900	-0.00000001	0.8591107	49.79636322	3948.38173166
DEX U1500	-0.0	0.43391649	68.53278328	7198.95765976
DEX D600	-0.00000001	0.72646872	-35.77045777	2299.83214784
DEX D900	-0.00000001	0.8591107	-49.79636322	3948.38173166
DEX D1500	-0.0	0.43391649	-68.53278328	7198.95765976

Difference (abs)

	Mean	Volatility	Skewness	Kurtosis
DEX U600	-0.00000023	-0.00946562	-0.45415292	-24.92928045
DEX U900	0.00000001	-0.01372315	-4.45024866	-869.6787484
DEX U1500	-0.00000003	-0.02323665	-7.27688687	-1672.15654493
DEX D600	0.0000001	0.01108013	-1.55845902	231.64633694
DEX D900	-0.0000001	0.02581702	-0.28952573	37.78852009
DEX D1500	-0.00000004	-0.00324293	3.96686843	-838.6124913

Difference (rel)

	Mean	Volatility	Skewness	Kurtosis
DEX U600	26.94998289	-0.01302964	-0.01269631	-0.01083961
DEX U900	-0.96290162	-0.01597367	-0.08936895	-0.22026207
DEX U1500	9.27296403	-0.05355097	-0.10618111	-0.23227759
DEX D600	-12.06696549	0.01525204	0.04356833	0.10072315
DEX D900	8.30539816	0.03005086	0.00581419	0.00957063
DEX D1500	11.82964329	-0.00747364	-0.05788279	-0.11649082

Moment Matching on Dev Data only

Feed Data Moments (Dev Data Only)

	Mean	Volatility	Skewness	Kurtosis
DEX U600	0.00000001	0.71840268	33.49477552	1965.20294821
DEX U900	-0.00000027	0.82993469	50.84547655	4102.38097316
DEX U1500	0.00000003	0.44320585	63.75175625	5996.42428316
DEX D600	-0.00000013	0.72896899	-33.43859023	1870.90422005
DEX D900	-0.00000025	0.88905901	-47.03864814	3373.85873422
DEX D1500	-0.00000013	0.47867262	-66.22513957	5992.897288

True Moments

	Mean	Volatility	Skewness	Kurtosis
DEX U600	-0.00000001	0.72646872	35.77045777	2299.83214784
DEX U900	-0.00000001	0.8591107	49.79636322	3948.38173166
DEX U1500	-0.0	0.43391649	68.53278328	7198.95765976
DEX D600	-0.00000001	0.72646872	-35.77045777	2299.83214784
DEX D900	-0.00000001	0.8591107	-49.79636322	3948.38173166
DEX D1500	-0.0	0.43391649	-68.53278328	7198.95765976

Difference (abs)

	Mean	Volatility	Skewness	Kurtosis
DEX U600	0.00000001	-0.00806604	-2.27568225	-334.62919963
DEX U900	-0.00000026	-0.02917602	1.04911332	153.9992415
DEX U1500	0.00000004	0.00928936	-4.78102703	-1202.5333766
DEX D600	-0.00000012	0.00250027	2.33186754	-428.92792779
DEX D900	-0.00000024	0.02994831	2.75771509	-574.52299744
DEX D1500	-0.00000012	0.04475613	2.30764371	-1206.06037176

Difference (rel)

	Mean	Volatility	Skewness	Kurtosis
DEX U600	-1.74963747	-0.01110307	-0.06361904	-0.14550157
DEX U900	22.38809714	-0.03396072	0.02106807	0.03900313
DEX U1500	-11.76561656	0.02140817	-0.06976263	-0.16704271
DEX D600	14.77945336	0.00344167	-0.06518976	-0.18650401
DEX D900	20.44369707	0.03485966	-0.05537985	-0.14550847
DEX D1500	41.01740137	0.10314456	-0.03367211	-0.16753264

Moment Matching on Combined Data

Feed Data Moments (Combined)

	Mean	Volatility	Skewness	Kurtosis
DEX U600	-0.00000012	0.71765247	34.46910274	2130.70946432
DEX U900	-0.00000013	0.83825829	47.82644862	3535.79249721
DEX U1500	-0.0	0.42606943	62.69202013	5813.94411069
DEX D600	-0.00000001	0.73358329	-35.5608073	2233.16634786
DEX D900	-0.00000017	0.88684544	-48.66281382	3699.50689559
DEX D1500	-0.00000008	0.45356051	-65.74089934	6220.25237644

True Moments

	Mean	Volatility	Skewness	Kurtosis
DEX U600	-0.00000001	0.72646872	35.77045777	2299.83214784
DEX U900	-0.00000001	0.8591107	49.79636322	3948.38173166
DEX U1500	-0.0	0.43391649	68.53278328	7198.95765976
DEX D600	-0.00000001	0.72646872	-35.77045777	2299.83214784
DEX D900	-0.00000001	0.8591107	-49.79636322	3948.38173166
DEX D1500	-0.0	0.43391649	-68.53278328	7198.95765976

Difference (abs)

	Mean	Volatility	Skewness	Kurtosis
DEX U600	-0.00000011	-0.00881625	-1.30135503	-169.12268352
DEX U900	-0.00000012	-0.02085241	-1.9699146	-412.58923446
DEX U1500	0.0	-0.00784706	-5.84076314	-1385.01354907
DEX D600	-0.0	0.00711457	0.20965047	-66.66579998
DEX D900	-0.00000016	0.02773473	1.1335494	-248.87483607
DEX D1500	-0.00000008	0.01964402	2.79188394	-978.70528332

Difference (rel)

	Mean	Volatility	Skewness	Kurtosis
DEX U600	13.64327165	-0.01213576	-0.03638072	-0.07353697
DEX U900	9.86389657	-0.02427209	-0.03955941	-0.10449578
DEX U1500	-0.48167082	-0.01808425	-0.08522583	-0.19239085
DEX D600	0.38050033	0.00979336	-0.00586099	-0.02898725
DEX D900	13.93337639	0.03228307	-0.0227637	-0.06303211
DEX D1500	25.36268183	0.04527143	-0.04073793	-0.13595097

Section 2

Here we check the parameters backward engineering from the feed data moments.

The result is highly dependable on the initial and boundary condition. The difference in the results are acceptable.

Feed Data Params

	Vol	Lambda	Probability	Positive Eta	Negative Eta
DEX U600	0.19885	261288.9	0.19885	0.0018915	0.0003977
DEX U900	0.2485625	174192.6	0.19885	0.00283725	0.0003977
DEX U1500	0.099425	52257.78	0.3977	0.0018915	0.0003977
DEX D600	0.19495306	254922.5395474	0.77218777	0.0003783	0.00192919
DEX D900	0.24402909	171015.585434	0.77110692	0.00039048	0.00289164
DEX D1500	0.099425	52257.78	0.56745	0.0003977	0.0018915

True Params

	Vol	Lambda	Probability	Positive Eta	Negative Eta
DEX U600	0.2	262800	0.2	0.002	0.0004
DEX U900	0.25	175200	0.2	0.003	0.0004
DEX U1500	0.1	52560	0.4	0.002	0.0004
DEX D600	0.2	262800	0.8	0.0004	0.002
DEX D900	0.25	175200	0.8	0.0004	0.003
DEX D1500	0.1	52560	0.6	0.0004	0.002

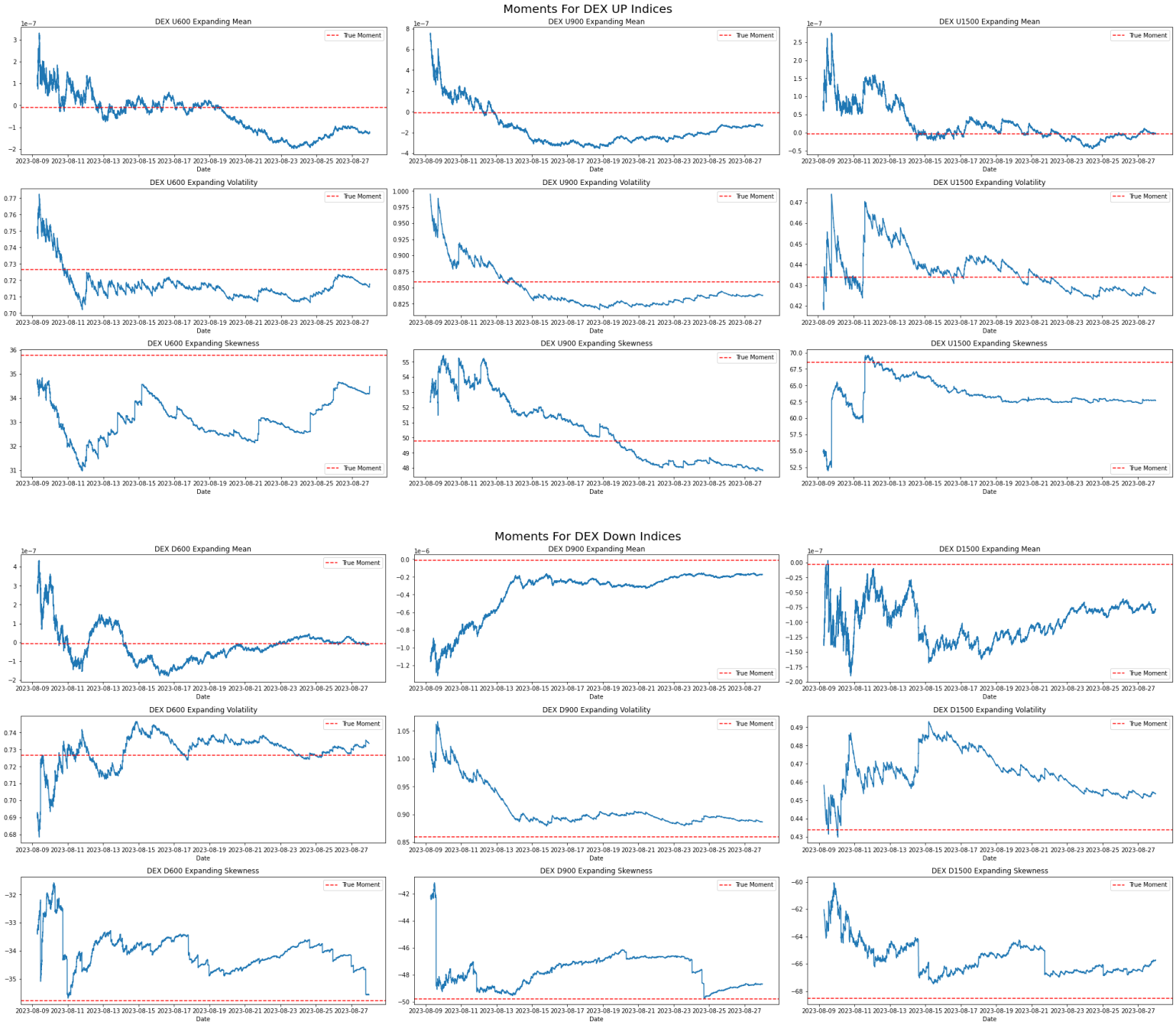
Difference (rel)

	Vol	Lambda	Probability	Positive Eta	Negative Eta
DEX U600	-0.00575	-0.00575	-0.00575	-0.05425	-0.00575
DEX U900	-0.00575	-0.00575	-0.00575	-0.05425	-0.00575
DEX U1500	-0.00575	-0.00575	-0.00575	-0.05425	-0.00575
DEX D600	-0.02523471	-0.02997512	-0.03476529	-0.05425	-0.03540599
DEX D900	-0.02388364	-0.02388364	-0.03611636	-0.02379041	-0.03612101
DEX D1500	-0.00575	-0.00575	-0.05425	-0.00575	-0.05425

Section 3

We want to check the convergence speed of the DEX feed data in term of the moments.

Overall looks fine.



Section 4

The simulation steps of the strategy testing are:

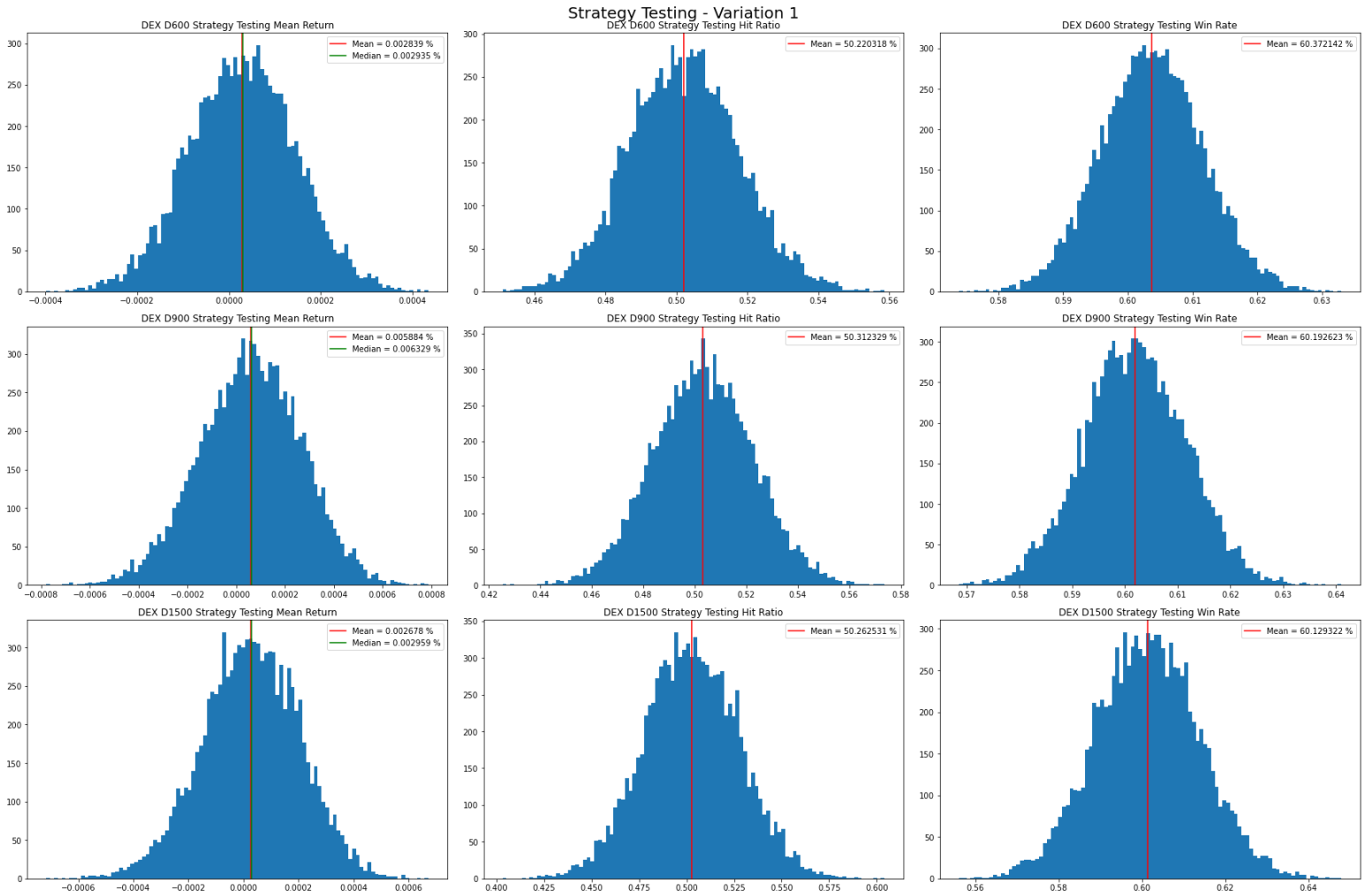
1. Run 3-months simulation for DEX Down 600/900/1500. Up indices is not run because it is just opposite direction.
2. Run the trading strategy on the simulation data.
    A. Define the jump size same as the negative eta.
    B. After each jump, wait for mean jump frequency (which is 600/900/1500 seconds respectively). If there is no jump, enter into a short position.
    C. Enter into additional short position every mean jump frequency if there is no jump.
    D. Exit all positions in next jump.
3. Repeat the strategy for a sufficient number of times. In here, it is 10K.
4. Plot the average PnL%, Hit Ratio and Win Rate.

In total there are 3 variations of this strategies are run too, which is to:

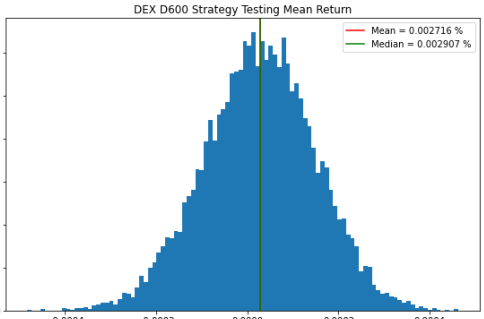
1. Waiting time and additional position frequency same as mean jump frequency.
2. Waiting time same as mean jump frequency but additional position frequency at 5 mins.
3. Double the waiting time and enter into additional positions every 5 mins.

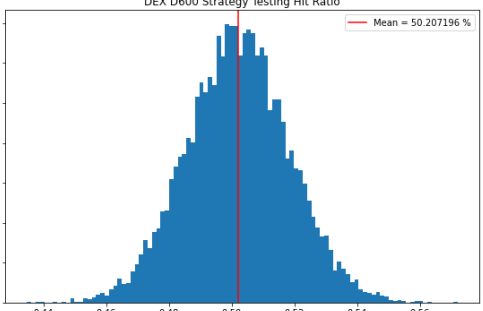
Key points to conclude the strategy testing:

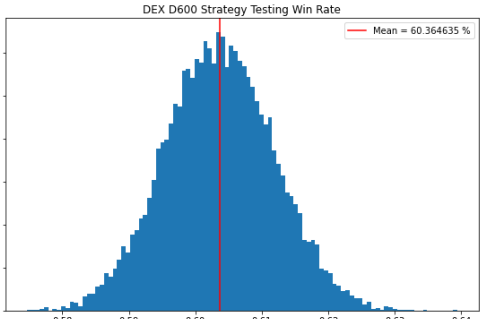
1. Mean Hit Ratio of 50% shows that the exploitation is not possible.
2. Mean Win Rate of 60% is expected due to the clear pattern of the index.
3. Spread of 0.01% is sufficient for DEX 900 as it covers the mean and median of the strategy PnL in %.
4. The strategy also shows that the spread of DEX 600/1500 can be lower than DEX 900, and as low as 50%. After discussion with Antoine, 75% of DEX 900 Spread will be the go-live decision.

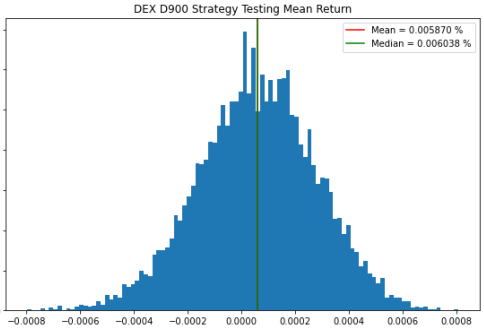


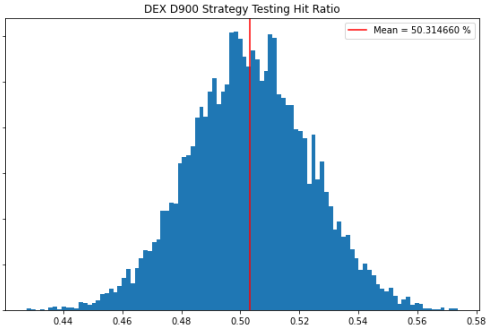
Strategy Testing - Variation 2

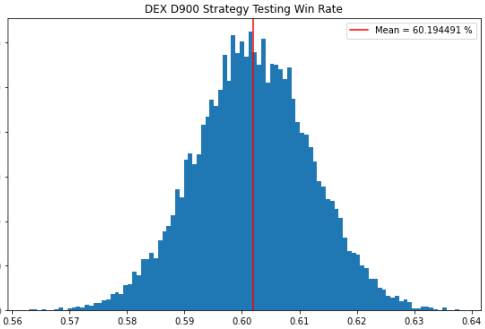


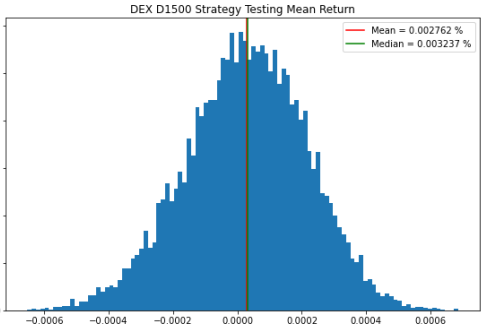


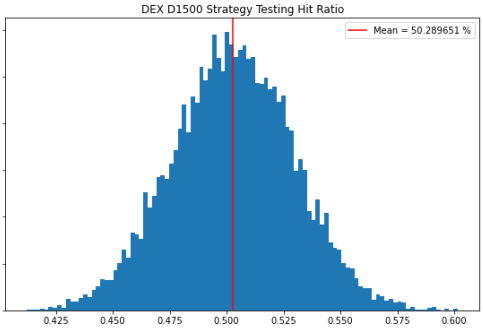


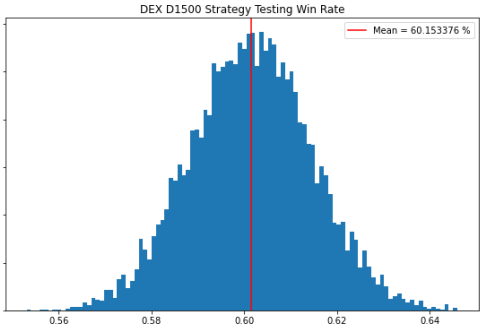




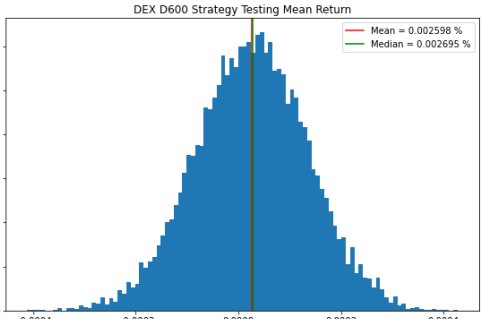


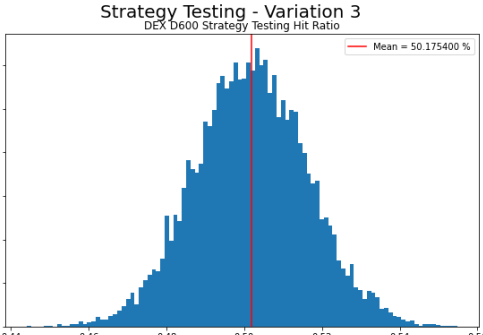


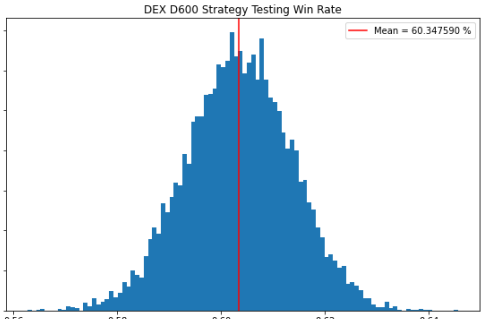


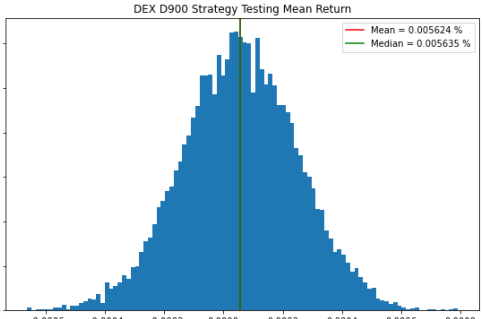


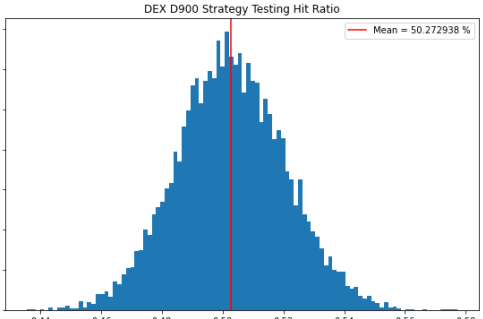
Strategy Testing - Variation 3

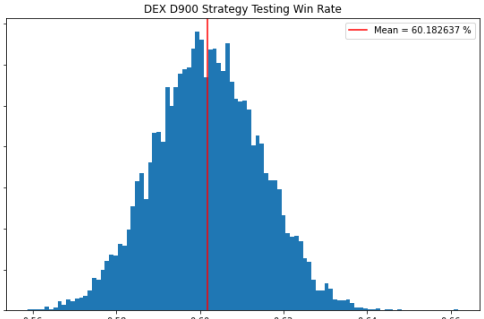


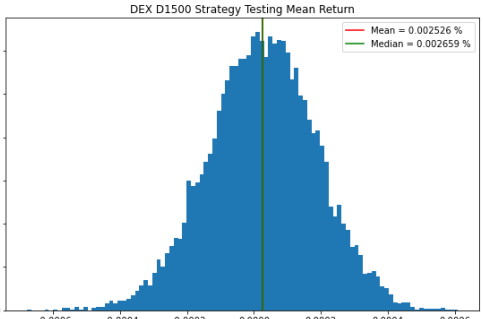


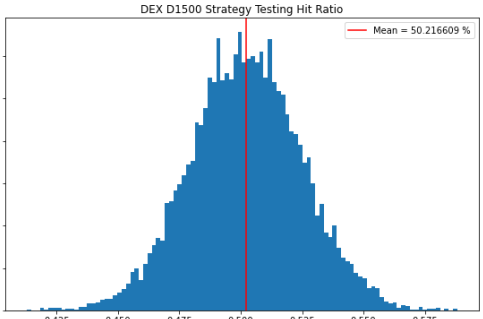


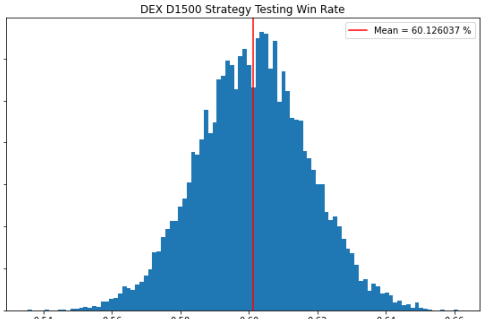












Section 5

In here we check the correlations between each UP or DOWN DEX indices. The correlation is important for the concentration risk diversification.

Overall, it looks fine.

For DEX UP

Tickly

	DEX U600	DEX U900	DEX U1500
DEX U600	1.00000000	-0.00005356	-0.00009738
DEX U900	-0.00005356	1.00000000	-0.00099314
DEX U1500	-0.00009738	-0.00099314	1.00000000

Hourly

	DEX U600	DEX U900	DEX U1500
DEX U600	1.00000000	0.08863632	0.00939919
DEX U900	0.08863632	1.00000000	-0.05071911
DEX U1500	0.00939919	-0.05071911	1.00000000

For DEX DOWN

Tickly

	DEX D600	DEX D900	DEX D1500
DEX D600	1.00000000	-0.00109056	0.00022100
DEX D900	-0.00109056	1.00000000	-0.00013249
DEX D1500	0.00022100	-0.00013249	1.00000000

Hourly

	DEX D600	DEX D900	DEX D1500
DEX D600	1.00000000	0.02069979	0.01597954
DEX D900	0.02069979	1.00000000	0.04598549
DEX D1500	0.01597954	0.04598549	1.00000000

R&D effort needs to be in line with Deriv's vision and mission as formulated by our CEO. Therefore all R&D projects are carefully selected by our C-Level senior management represented by JY and Rakshit and resources for the projects are only allocated after review and shortlisting based on their vision and priorities.

In line with the standards and criterias set out by the CEO, the Model Validation team has validated the product/indices as documented in this report.