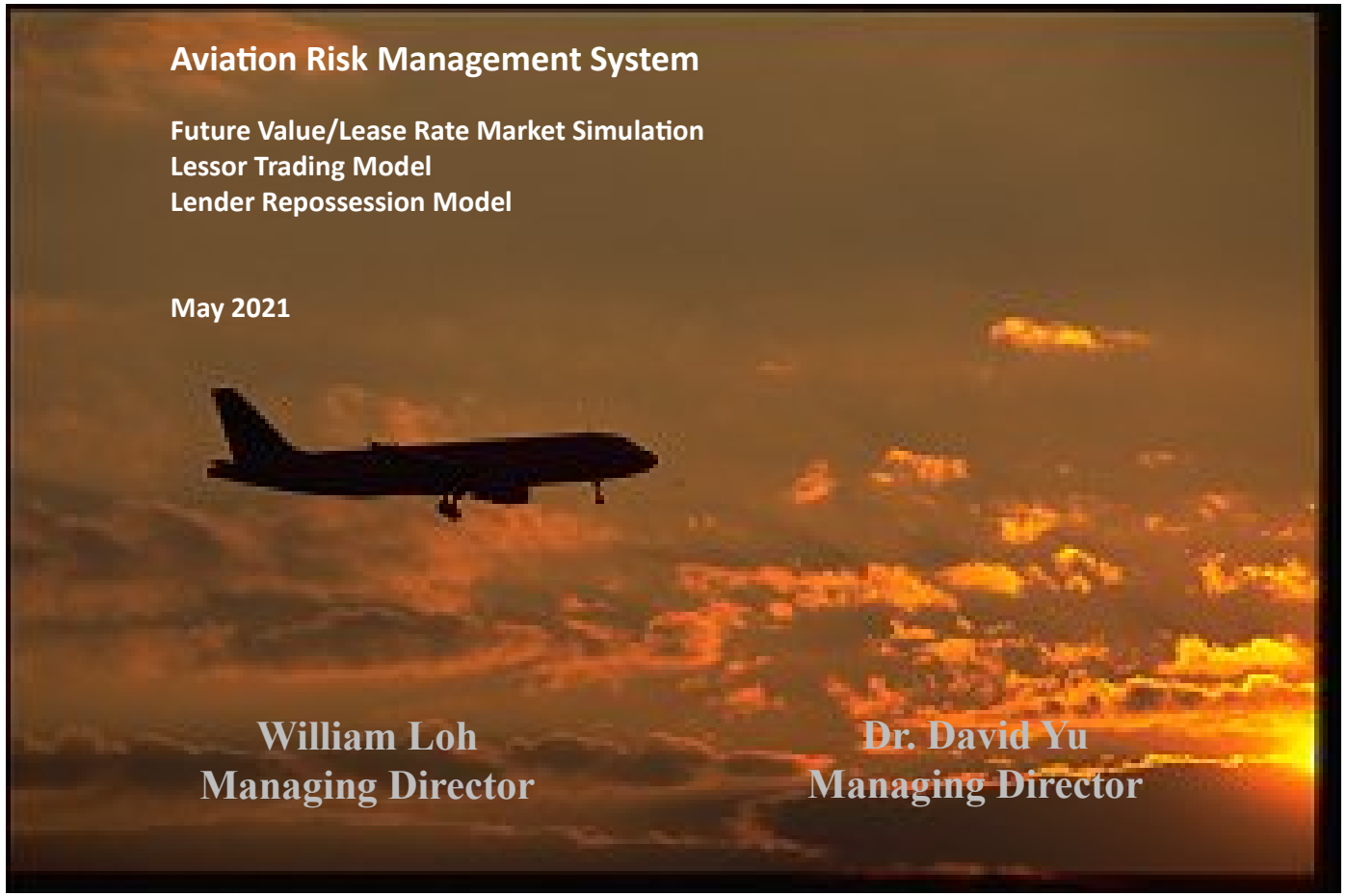
Aviation Risk Management System
Future Value/Lease Rate Market Simulation
Lessor Trading Model
Lender Repossession Model
May 2021
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Dr. David Yu
Managing Director

International Aviation Advisors has worked for many years to develop a new valuation forecast methodology for commercial aircraft, as an innovative and scientific means of evaluating the future price of those assets.

We are pleased to announce that China Aviation Valuation Advisors has now joined us as a Development Partner, and we look forward to working with Dr. David Yu to build on our thought leadership, and improve the intellectual integrity of the forecasts and the ARMS system as a whole. We want to congratulate Dr. Yu on his recent selection as a Fellow of the Royal Aeronautical Society.

Rather than produce a bi-annual static forecast of future values, our approach has been to be more logically relevant and to develop a simulation model of possible future outcomes. This approach results in a market-driven probability distribution of the future asset value, rather than a single forecast at a future point (rarely achieved in practice). We can also update our forecasts whenever we think that is appropriate.

Even before Dick Forsbergs's famous White Paper of 2017, it had become clear to us that there was a need for a more serious analytical methodology. We have also found that there is often a requirement for an investment return and pricing model that can assist existing and potential investors in estimating the critical assumptions in their analysis of existing portfolios and for evaluating new purchases.

Opportunity

Given the unprecedented disruption to the aviation sector following the effects of the pandemic and lockdowns, many of those who have invested in aircraft over the last decade are faced with new uncertainty in terms of lease rates, values and even future market demand for aircraft. This may indicate the need for a review of their internal models. No one has a crystal ball that provides absolute clarity on the recovery time, but investors will want to model a variety of scenarios, especially for twin-aisle aircraft.

As with any downturn, this low part of the cycle is producing opportunities for investors that wish to take advantage of some of the inevitable market price dislocations, and the uptrend that will come as the travel industry emerges from the downturn.

All investors have an interest in properly analysing the impact that this uncertainty may have on their returns, the timing of selling existing aircraft exposure, or the price at which it will make sense for new investors to buy or build an aircraft portfolio.

The ARMS combines the market simulation approach to future aircraft valuations with a powerful analysis of future cashflows to provide decision-makers with a pricing and return model under different scenarios. The Lessor Trading Model helps investors understand the potential returns available as well as some potential pitfalls for the unwary. The Lender Repo Model allows lenders to understand the benefits available to them by choosing to lease an aircraft instead of pursuing a possibly distressed sale.

The two largest expenses of a leasing company are depreciation and finance costs. The main LTM lease parameters are therefore:

- Debt/equity split of the purchase price
- Debt terms, including rates, fees, margin and balloon payments
- Lease terms, including monthly rentals and maintenance reserves
- Downtime, if any
- Depreciation policy, and residual value assumptions
- Lease extension, or a new lessee
- Future sale value
- For the right aircraft, analysing passenger-to-freighter conversions towards the end of the normal useful life.

Leasing Software and Expertise

We've written the ARMS system logic in Python code (a high level programming language for data science) so we have total control and can customise the process. We use the Django framework to deliver the software securely to our clients. Use of the software is available by logging in through a web browser (we recommend Firefox) and our licenses are as follows:

- Transaction-based or Annual Licences
- One-off analysis of potential investments
- Special Projects

We can also provide advisory services, including:

- Assistance on market and transaction risk analysis
- Aircraft selection and sourcing
- Targeting of potential portfolios
- Audits of your internal models and processes.

Why invest in aircraft…?

Commercial aircraft are attractive assets to lease as they are easily recoverable, and produced by a stable duopoly of manufacturers. In normal times, aircraft generate fairly predictable USD lease flows over their long economic lives and there is no near-term risk of technological obsolescence, especially for the latest generation narrow-bodies.

Demand for travel drives demand for aircraft, and on average, the aircraft fleet has doubled approximately every 15 years as the travel demand has risen by 5% annually. Passenger growth has grown by 1.6 to 2 times world GDP growth over the last 30 years, but these relationships are currently being shaken to the core.

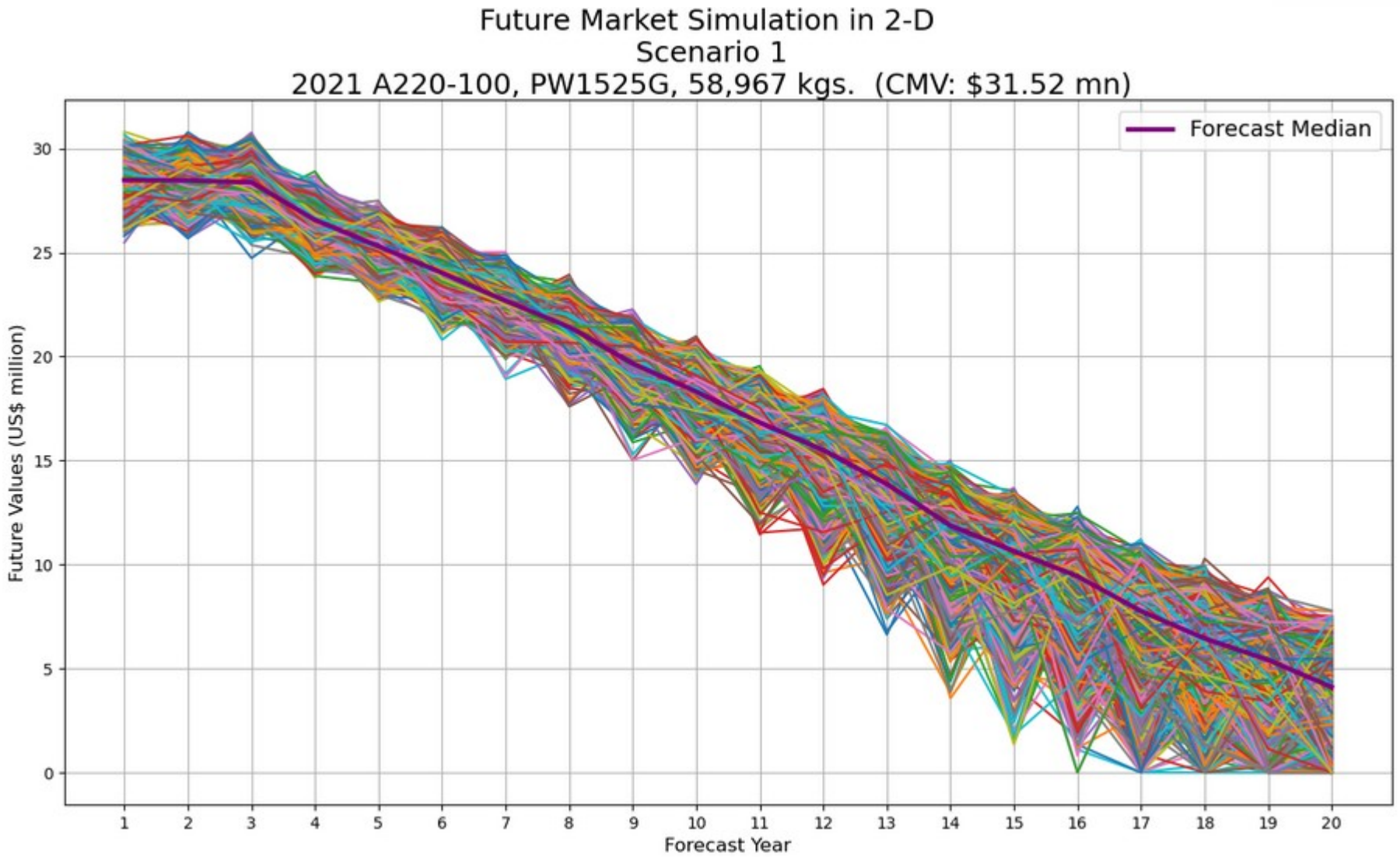
The airline industry is a derivative of the economic cycle, and it is also prone to occasional external shocks as the result of war, terrorism or as we are currently experiencing, disease. Historically the industry has a proven resilience to these shocks, and over the last 30 years has generally recovered within a relatively short time, with demand reverting to the long-term trend line.

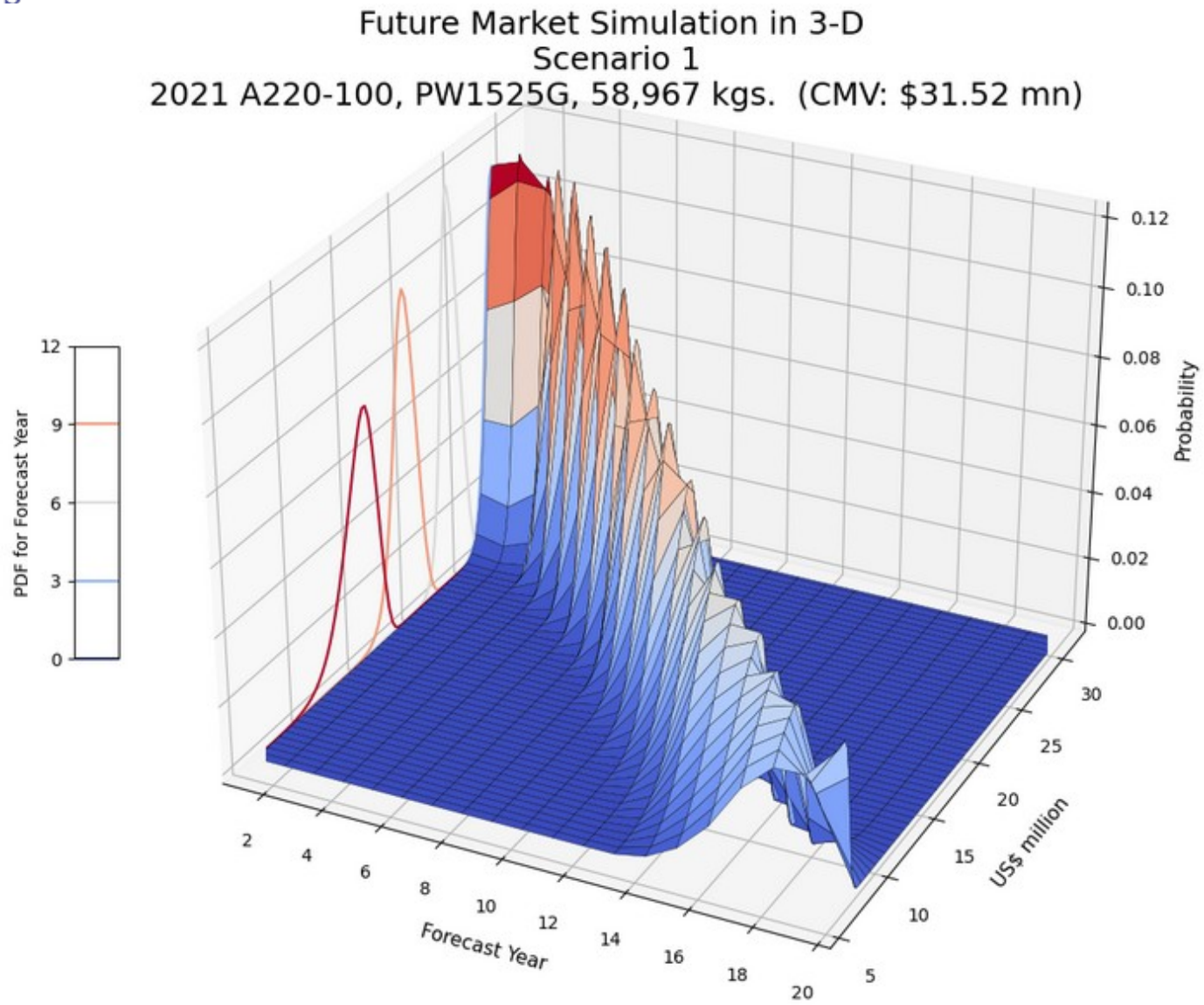
Why do aircraft investors need risk models…?

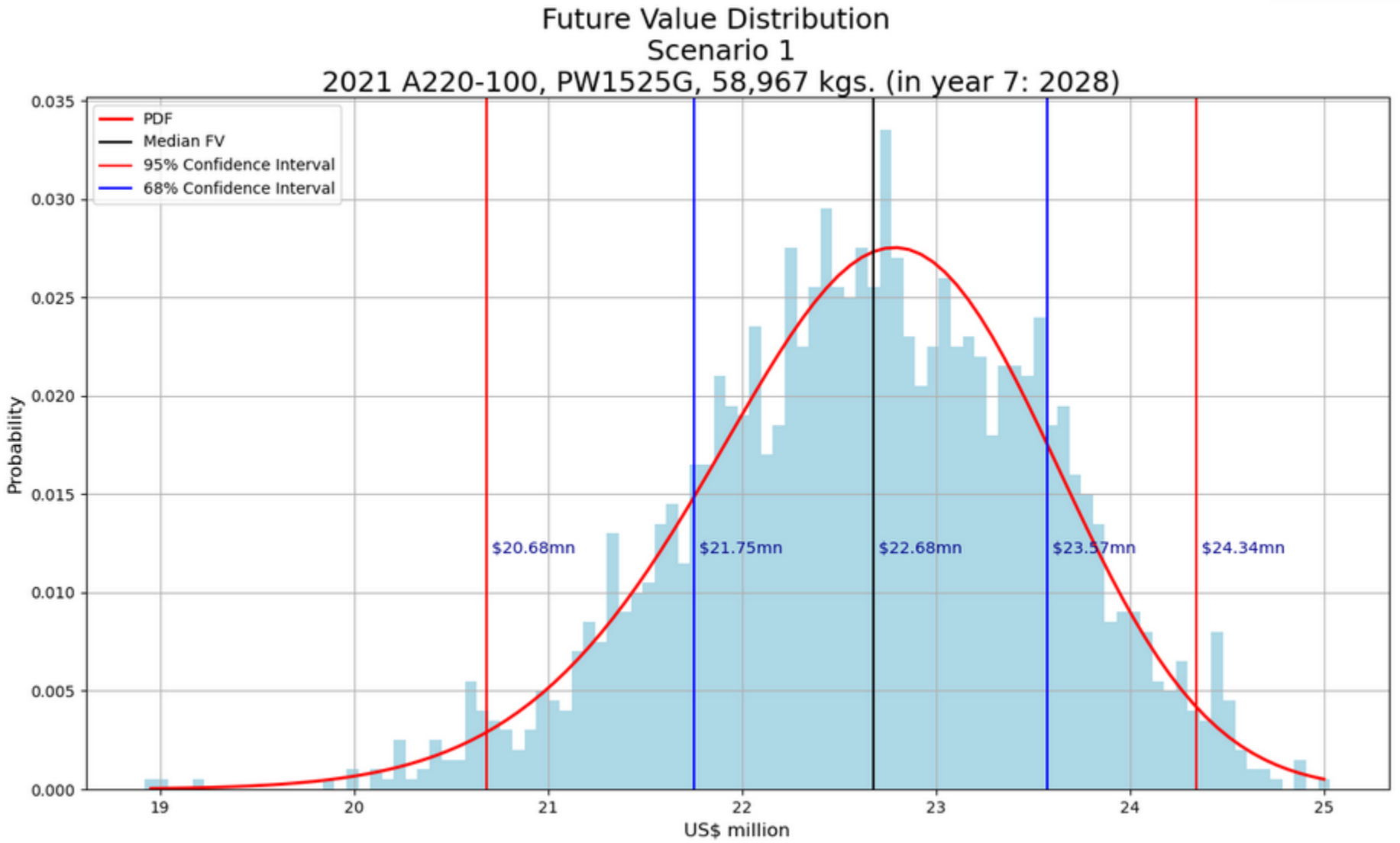
We have worked with a diverse number of aircraft investors and have been concerned by the variety of approaches to risk analysis and the logic used to justify and manage some transactions. Some future value models we are aware of have not been improved or invested in for decades.

Based on our multi-cycle experience (of winners and losers), we believe that investors would benefit from third-party models developed by a knowledgeable and independent group to verify the assumptions of their internal models, and support them if they need this.

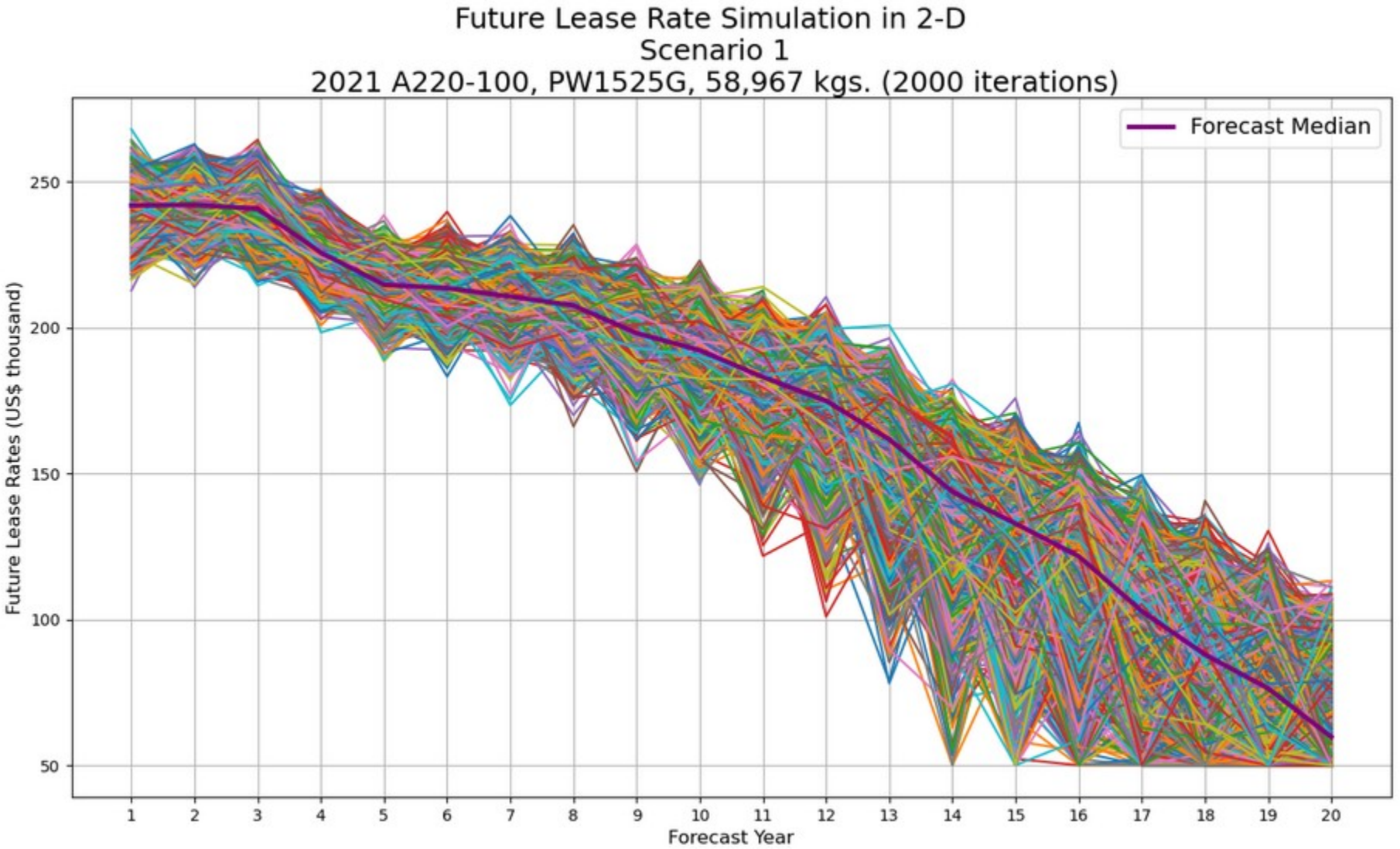
The ARMS system allows investors to use our forecast value distributions and IRR model to analytically evaluate the returns on their portfolio. Our future value/lease rate model is based on a logically constructed simulation of the market for commercial aircraft. The ouput is as follows:


Future Market Simulation in 2-D
Scenario 1
2021 A220-100, PW1525G, 58,967 kgs. (CMV: $31.52 mn)
Forecast Median
Future Values (US$ million)
Forecast Year
0
5
10
15
20
25
30
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

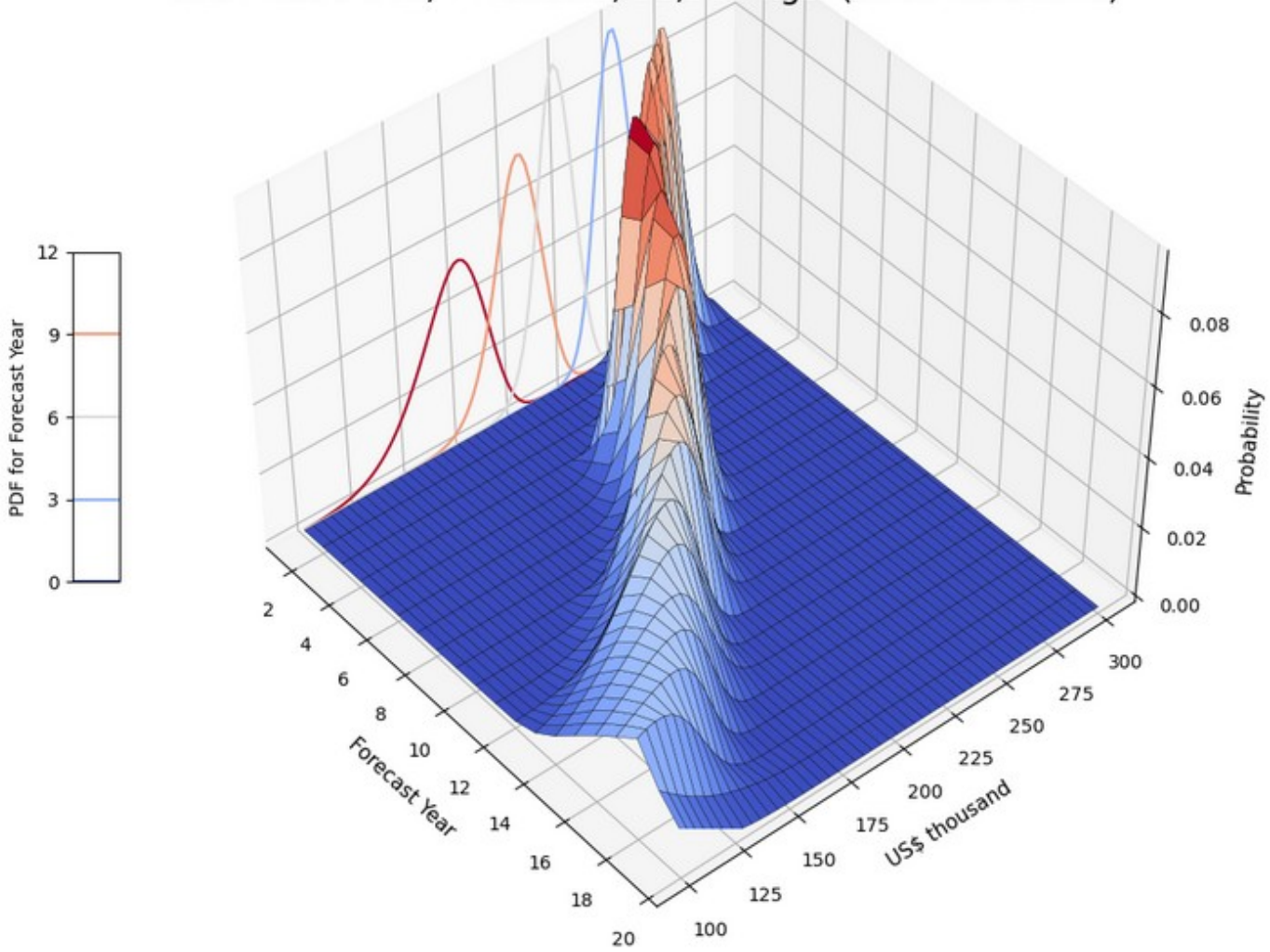

Future Market Simulation in 3-D
Scenario 1
2021 A220-100, PW1525G, 58,967 kgs. (CMV: $31.52 mn)
PDF for Forecast Year
12
9
6
3
0
Forecast Year
2
4
6
8
10
12
14
16
18
20
US$ million
5
10
15
20
25
30
Probability
0.12
0.10
0.08
0.06
0.04
0.02
0.00


Future Value Distribution
Scenario 1
2021 A220-100, PW1525G, 58,967 kgs. (in year 7: 2028)
PDF
Median FV
95% Confidence Interval
68% Confidence Interval
$20.68mn
$21.75mn
$22.68mn
$23.57mn
$24.34mn
Probability
US$ million
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
19
20
21
22
23
24
25

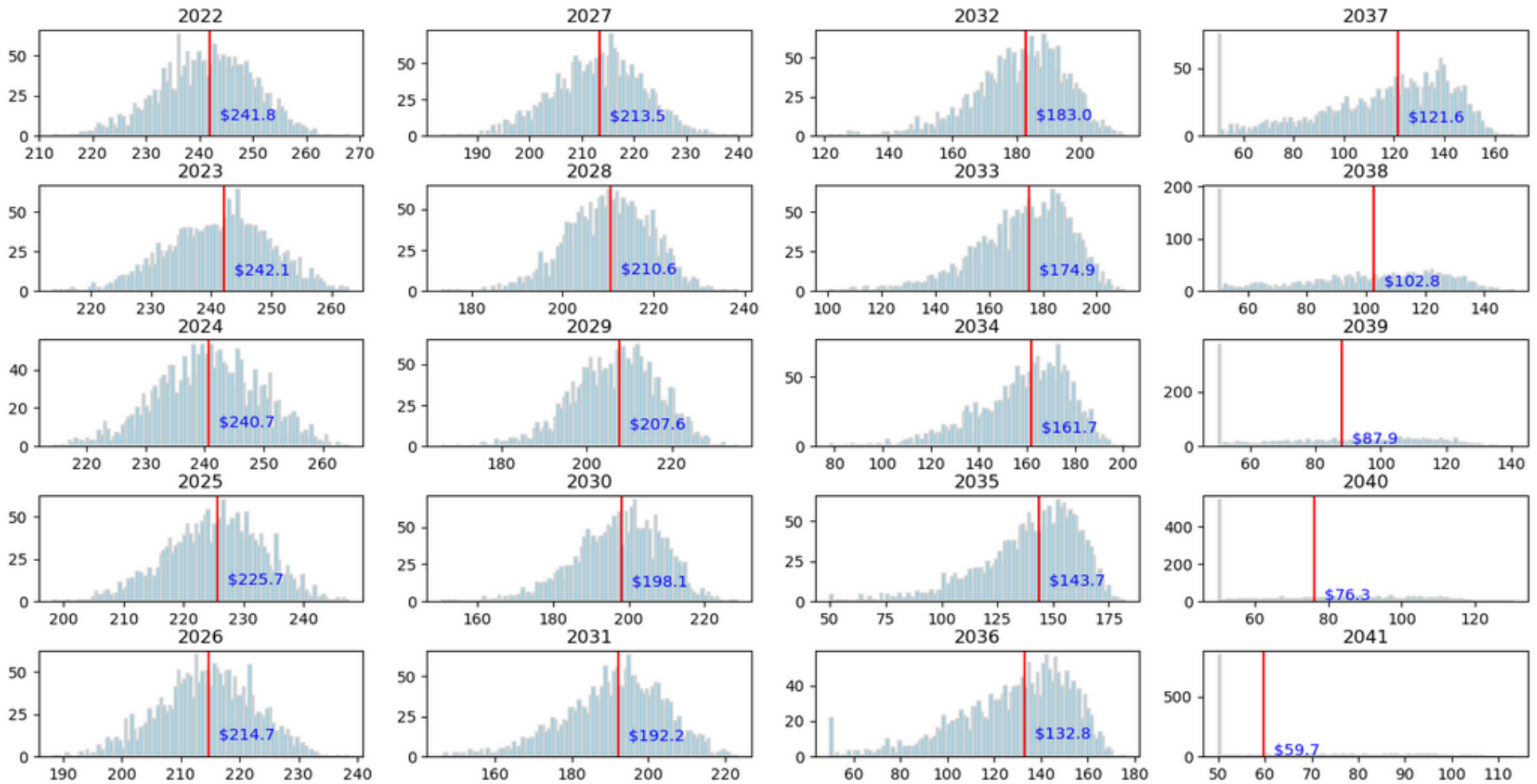
And this is the Lease Rate forecast:



Future Lease Rate Simulation in 3-D
Scenario 1
2024 A220-100, PW1525G, 58,967 kgs. (2000 iterations)



Lease Rate forecasts for 20 years:



The LTM can be used to examine existing assumptions for changes in lease rentals (lower re-lease rates, or a payment deferral) as well as the downward trend in market values. Various scenarios can be accurately modelled, including lease downtime, and the model's results have been tested and verified by several large lessors. The IRR is derived from valid cash inflows and outflows over the term of the deal, which take into account all of the necessary parameters on a monthly basis. The logic is based on normal accounting practices, and the underlying cash movements will drive results and decisions to buy or sell.

The LTM also includes three Solver functions that can be used to determine the lease rate, debt/equity split or future sale amount required to achieve a target return based on a certain assumption set for the other parameters.

We also account for maintenance reserve and expected spend amounts, as well as the current maintenance status of the individual aircraft. We also allow the ability to include a percentage of the MR payments as income, which has become more accepted by auditors in a number of jurisdictions.

Model Outputs

Once the underlying lease parameters have been entered, the User will choose a future sale year and value. The LTM will then evaluate the sale of the aircraft at that date and also for sales at book value in the chosen year and subsequent three years. So we have an IRR for each of these five sale dates and amounts.

The result is that investors will gain a reasonable view of pricing and future value risk, together with the possible investment returns from book-value sales in the transaction time horizon. It also gives them a review of their depreciation policies against expected market values, and whether they should assume a book gain or loss on disposal, and adjust the other parameters accordingly. The bottom line: Managers can get their numbers right.

The LTM also includes a simulation module which will provide the investor with a probability distribution of IRRs, based on the inherently random uncertainty involved in some of those same parameters.

Lease Downtime

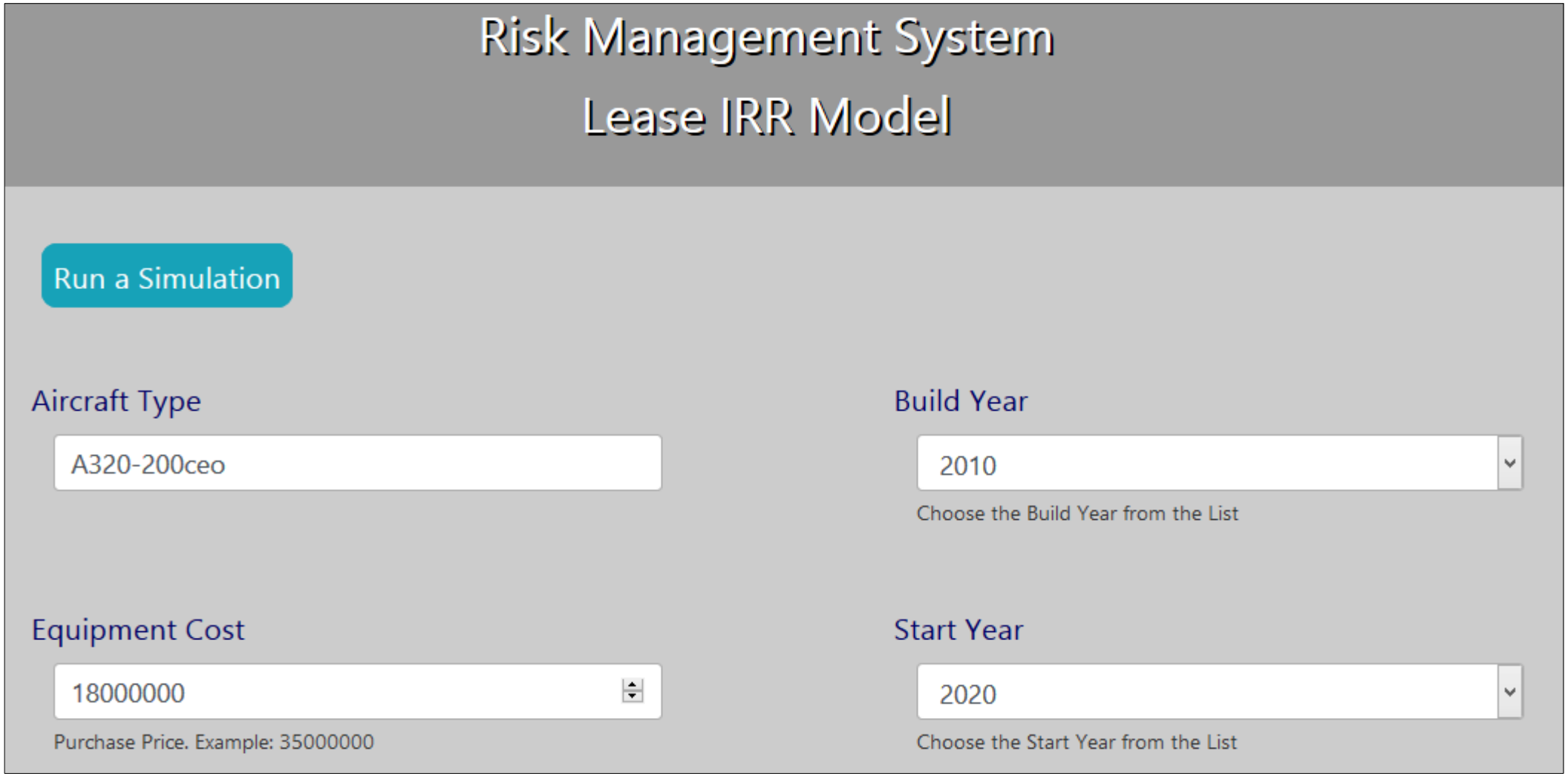
The lease downtime logic provides three possible scenarios (none, 6 months or 12 months), but this can be customised to meet your own requirements.

For riskier lessees, the analysis can be adapted to assume downtime, additional costs (such as aircraft repossession/storage/re-configuration etc.), and discounted re-lease rates. The Solver functions can then be utilised to model the parameters that might still allow the investor to meet their return targets under these constraints.

By running different scenarios in the LTM and using the IRR simulation module, investors can make prudent risk-based portfolio return decisions.

In the next section we will demonstrate examples of the input displays and the model outputs.

After logging in through your browser, the lease parameters are entered on this User form:



The relevant parameters are all included:

Start Month

9

Enter the Start Month as an Integer. Example: September = 9

Debt Percentage vs. Equity

0.80

Example: .75 (Range: 0 - .90)

Balloon Payment

0.0

Enter the Balloon Payment as a Percent. Example: .25

Debt Interest Rate

0.055

Example: .055 (for 5.5%)

Debt Fees (monthly)

7000

Example: 5000

Debt Term

12

Example: 12

Annual Salaries and Other Costs

1000000

Example: 1000000

Total Aircraft in Portfolio

10

Example: 10

We can also analyze freighter conversions, and possible lease downtime:

Lease Term

12

Example: 12

Lease Rate

200000

Example: 390000

Future Sale Year

2028

Future Year for Aircraft Sale

Future Sale Price

11000000

Future Sale Amount. Example: 12000000

Useful Life Added for Freighter Conversion

0

Example: 7 to 15 years

Residual Value

0

Depreciate down to this percent of the beginning Book Value (Equipment Cost). Example: .10

Analyse the IRR under Lease Downtime Scenarios

0

Lease Downtime Period (in 4th Year): Enter 0 for none, or 1 for 6 months, or 2 for 12 months

First Maintenance Spend Event

1000000

Example: 1000000

The Maintenance Reserves and spend amounts are also taken into account:

Second Maintenance Spend Event

1000000

Example: 1000000

Third Maintenance Spend Event

1000000

Example: 1000000

Beginning MR Account Balance

0.0

Example: 1000000

Percent of MR Payments to include in Income

0.0

Example: .1

Percent of MR Account for Seller (if Aircraft is Sold)

1.0

Example: Enter .5 for 50% (or 1.0 for 100%)

Solvers: Input Target IRR to Solve For

0.1

Example: Using .1 here will solve for a 10% IRR

After entering your parameters, and running the code, this is the displayed result:

Risk Management System

Lease IRR Model

Aircraft Type:	A320-200ceo	**Build Year:**	2010	**Equipment Cost:**	18,000,000
UL Remaining:	15	**Debt Term:**	12	**Lease Term:**	12
Debt Rate:	5.50 %	**Loan Payment:**	136,825	**Lease Rate:**	200,000
Depreciation:	100,000	**Start Year:**	2020	**Sale Year:**	2028
Sale Price:	11,000,000	**Debt vs. Equity:**	80 %	**Downtime:**	None
IRR:	19.1 %				

IRRs for Sales at Book Value

Year	**2028**	**2029**	**2030**	**2031**
Book Values:	8,100,000	6,900,000	5,700,000	4,500,000
IRR for Book Value Sale:	11.203 %	13.094 %	16.852 %	19.177 %

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Solvers: By checking a box, we can run a Solver routine to calculate the 2028 Sale Price required to achieve a target IRR (10% in this case):

☑ Solve for Sale Price to achieve Target

Aircraft Type:	A320-200ceo	**Build Year:**	2010	**Equipment Cost:**	18,000,000
UL Remaining:	15	**Debt Term:**	12	**Lease Term:**	12
Debt Rate:	5.50 %	**Loan Payment:**	136,825	**Lease Rate:**	200,000
Depreciation:	100,000	**Start Year:**	2020	**Sale Year:**	2028
Sale Price:	7,805,195	**Debt vs. Equity:**	80 %	**Downtime:**	None
IRR:	10.0 %				

Or we can solve for the Lease Rate:

Equipment Cost:	18,000,000
Lease Term:	12
Lease Rate:	181,030
Sale Year:	2028
Downtime:	None

Or the Debt/Equity split:

Build Year:	2010
Debt Term:	12
Loan Payment:	113,653
Start Year:	2020
Debt vs. Equity:	67 %

By choosing simulation ranges for the main parameters, our model takes into account the uncertainty involved

Lease Rate
200000
Example: 390000

Lease Rate Simulation Upper Limit
0.05
Example: .10

Lease Rate Simulation Lower Limit
0.05
Example: .05

Future Sale Year
2028
Future Year for Aircraft Sale

Future Sale Price
11000000
Future Sale Amount. Example: 12000000

Sale Price Simulation Upper Limit
0.05
Example: .10

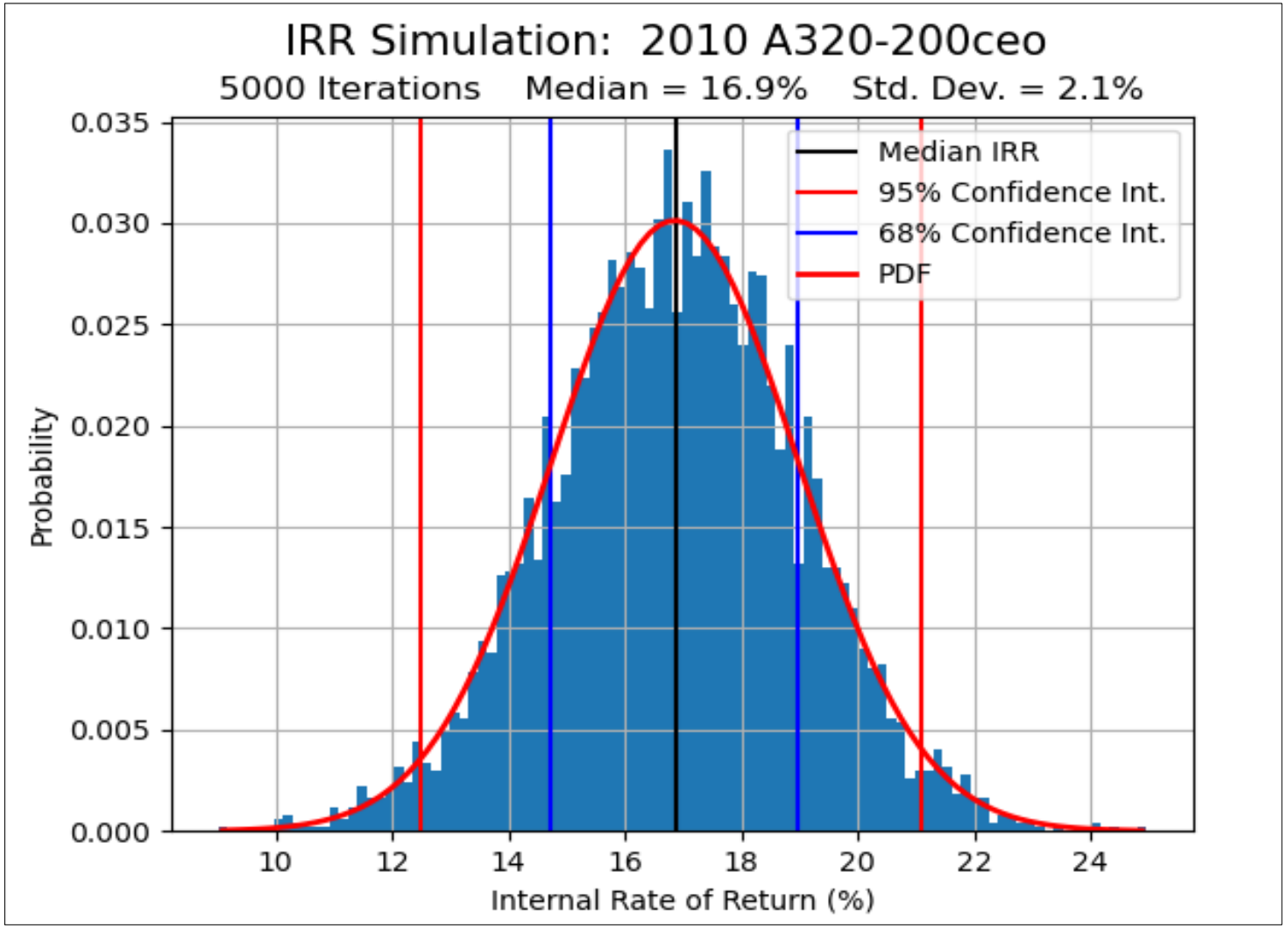
Sale Price Simulation Lower Limit
0.05
Example: .10

Useful Life Added (for Freighter Conversion)
0
Example: 7 to 15 years

The Simulation Module results in a probability distribution of IRRs.

The simulation code allows our models to take advantage of the random number generator in the computer.

The simulation results displayed include confidence intervals and the probability density curve.



We have invested in the necessary research and development, with a view to expanding our thought leadership, and improving on the status quo.

By using simulation, and some other innovative ideas, we feel that we have done, and this process will continue.

Our multi-cycle experience, market expertise, and innovative models can help your company understand the risks involved more clearly, better inform your business decisions, and maximise your future returns.