Stress Testing Your Portfolio of Exploration Projects

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ABSTRACT

The best exploration portfolio is the aggregation of projects that best meets or exceeds key corporate objectives, usually though maximizing value and minimizing financial risk. Unfortunately, the annual results of exploration portfolios are notoriously volatile and of particular concern when that volatility results in the objectives not being met. Fortunately, there may be a way to predict the possibility of this type of disappointing outcome.

Cardiac stress tests have been conducted for many years by cardiologists. They are designed to identify a possible but not obvious weakness in the cardiac system under controlled conditions before it occurs in daily life. This concept is now applied in the financial industry via the Dodd Frank Act Stress Test (DFAST). Many non-financial companies are now designing stress tests of their own (Vaughan, 2008). Instead of just doing financial analysis on a mean case, companies now consider scenarios where disappointing combinations of different events combine together. The stress test will increase confidence that the portfolio will generate results required within designated controls (Schmieder, 2011).

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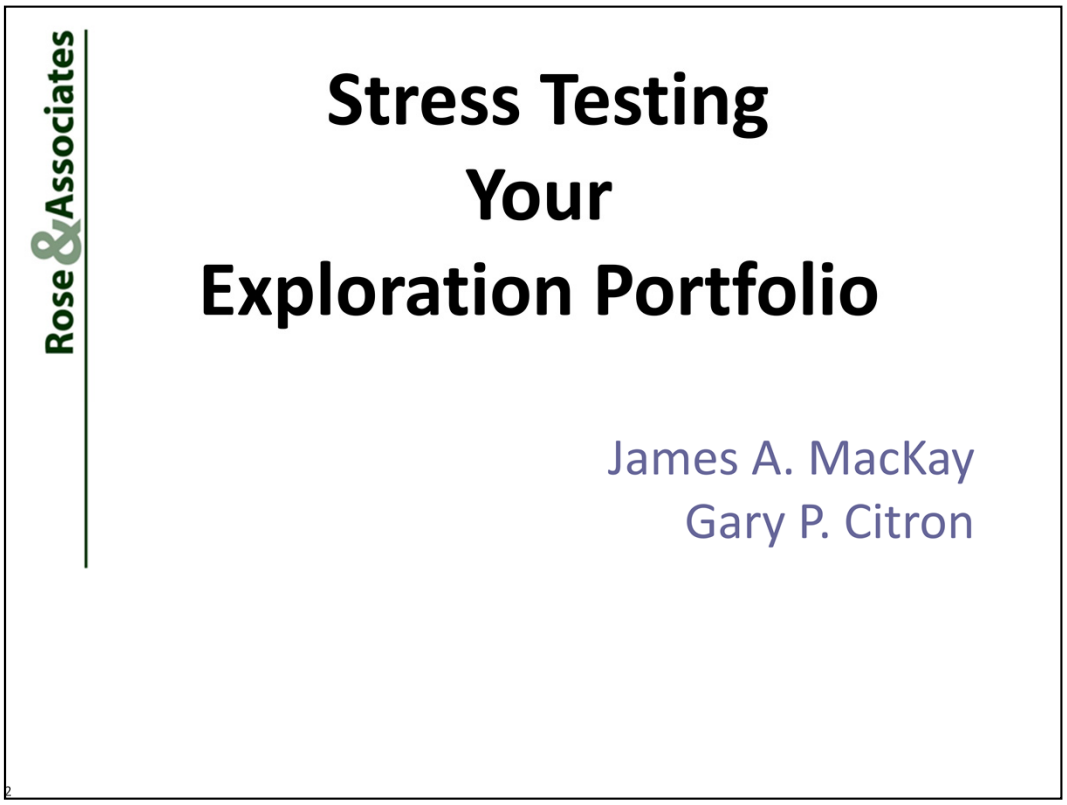

I have been investigating investment strategies applied in other industries. This is one example from the banking community.

The objective is to determine the impact of a series of unrelated negative events that might happen simultaneously.

The Exploration Portfolio….

1. Designed to meet value objectives
2. Often notoriously volatile
   Because estimates are uncertain.
3. Frequently underperforms
   Because the mean (or greater value) of the forecast for any specific project is often a lower probability event than perceived

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We design exploration portfolios to meet certain financial objectives but are aware the results can be volatile and frequently underperform.

Prone to Volatile Performance….

1. Some projects meet or exceed estimates.
2. Most projects disappoint.
   The mean of the forecast is not achieved about two thirds of the time.
   The value, cost and chance are uncertain and may have been optimistic estimates.

One remedy is to stress test the portfolio

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Although that volatility might result in a beneficial surprise it frequently is just the opposite.

Stress Testing All Projects….

Following the 2008 financial crisis, this process has become common for managing capital adequacy at major banks.

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Projects can be tested to determine which are more sensitive to unpredictable negative results vs estimates.

Stress Testing All Projects….

Following the 2008 financial crisis, this process has become common for managing capital adequacy at major banks.

A stress test is designed to identify investments that are more sensitive to a run of bad luck than others.

For example, if the actual value, cost and chance are all optimistic by 10%, which projects will be most impacted?

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Projects can be tested to determine which are more sensitive to unpredictable negative results vs estimates.

The Method: Rating Projects….

RR = Relative Risk:

Probability of commercial failure (1 – Pc) times the cost at risk (C). RR = (1 – Pc) x C.

RATE = Relative Ranking:

Divide the Expected Value (EV) by the Relative Risk (RR). RATE = EV / RR.
Higher Rank order is a larger number

A rating criteria needs to be devised to compare performance with and without stress applied.

The Method: Rating Projects….

Read the paper for more detail

PV = G - C

Prospect Name	Gain (G)	Chance (Pc)	Cost (C)	Present Value (PV)
A	$ 1,107	24%	$ 177	$ 930
B	$ 542	18%	$ 72	$ 470
C	$ 129	76%	$ 47	$ 82
D	$ 2,333	28%	$ 146	$ 2,187
E	$ 1,464	20%	$ 147	$ 1,316
F	$ 356	60%	$ 104	$ 252
G	$ 96	93%	$ 70	$ 26
H	$ 1,540	45%	$ 140	$ 1,400
I	$ 1,440	40%	$ 190	$ 1,250
J	$ 926	40%	$ 125	$ 801
	dollars in Millions			

I tested this portfolio of a sample of low to high risk, cost and value projects. First calculate the present value (PV).

The Method: Rating Projects….

Read the paper for more detail

RR = (1-Pc) x C

Prospect Name	Gain (G)	Chance (Pc)	Cost (C)	Present Value (PV)	Relative Risk (RR)
A	$ 1,107	24%	$ 177	$ 930	$ 135
B	$ 542	18%	$ 72	$ 470	$ 59
C	$ 129	76%	$ 47	$ 82	$ 11
D	$ 2,333	28%	$ 146	$ 2,187	$ 105
E	$ 1,464	20%	$ 147	$ 1,316	$ 117
F	$ 356	60%	$ 104	$ 252	$ 42
G	$ 96	93%	$ 70	$ 26	$ 5
H	$ 1,540	45%	$ 140	$ 1,400	$ 77
I	$ 1,440	40%	$ 190	$ 1,250	$ 114
J	$ 926	40%	$ 125	$ 801	$ 75
	dollars in Millions				

Next calculate the relative risk (RR). It is a function of the cost at risk (C) times the chance of loss (1-Pc).

The Method: Rating Projects….

Read the paper for more detail

EV = (Pc x G) - C

Prospect Name	Gain (G)	Chance (Pc)	Cost (C)	Present Value (PV)	Relative Risk (RR)	Expected Value (EV)
A	$ 1,107	24%	$ 177	$ 930	$ 135	$ 89
B	$ 542	18%	$ 72	$ 470	$ 59	$ 25
C	$ 129	76%	$ 47	$ 82	$ 11	$ 51
D	$ 2,333	28%	$ 146	$ 2,187	$ 105	$ 510
E	$ 1,464	20%	$ 147	$ 1,316	$ 117	$ 150
F	$ 356	60%	$ 104	$ 252	$ 42	$ 109
G	$ 96	93%	$ 70	$ 26	$ 5	$ 19
H	$ 1,540	45%	$ 140	$ 1,400	$ 77	$ 553
I	$ 1,440	40%	$ 190	$ 1,250	$ 114	$ 386
J	$ 926	40%	$ 125	$ 801	$ 75	$ 245
	dollars in Millions					

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Third calculate the expected value.

The Method: Rating Projects….

Read the paper for more detail

RATE = EV / RR

Prospect Name	Gain (G)	Chance (Pc)	Cost (C)	Present Value (PV)	Relative Risk (RR)	Expected Value (EV)	Rating (RATE)
A	$ 1,107	24%	$ 177	$ 930	$ 135	$ 89	0.7
B	$ 542	18%	$ 72	$ 470	$ 59	$ 25	0.4
C	$ 129	76%	$ 47	$ 82	$ 11	$ 51	4.6
D	$ 2,333	28%	$ 146	$ 2,187	$ 105	$ 510	4.9
E	$ 1,464	20%	$ 147	$ 1,316	$ 117	$ 150	1.3
F	$ 356	60%	$ 104	$ 252	$ 42	$ 109	2.6
G	$ 96	93%	$ 70	$ 26	$ 5	$ 19	3.8
H	$ 1,540	45%	$ 140	$ 1,400	$ 77	$ 553	7.2
I	$ 1,440	40%	$ 190	$ 1,250	$ 114	$ 386	3.4
J	$ 926	40%	$ 125	$ 801	$ 75	$ 245	3.3
	dollars in Millions						

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Finally apply a relative rating (RATE) based on the ratio of the expected value (EV) to the relative risk (RR).

The Method: Rating Projects….

Read the paper for more detail

Higher Rank order is associated with larger RATE

Prospect Name	Gain (G)	Chance (Pc)	Cost (C)	Present Value (PV)	Relative Risk (RR)	Expected Value (EV)	Rating (RATE)	Rank
A	$ 1,107	24%	$ 177	$ 930	$ 135	$ 89	0.7	2
B	$ 542	18%	$ 72	$ 470	$ 59	$ 25	0.4	1
C	$ 129	76%	$ 47	$ 82	$ 11	$ 51	4.6	8
D	$ 2,333	28%	$ 146	$ 2,187	$ 105	$ 510	4.9	9
E	$ 1,464	20%	$ 147	$ 1,316	$ 117	$ 150	1.3	3
F	$ 356	60%	$ 104	$ 252	$ 42	$ 109	2.6	4
G	$ 96	93%	$ 70	$ 26	$ 5	$ 19	3.8	7
H	$ 1,540	45%	$ 140	$ 1,400	$ 77	$ 553	7.2	10
I	$ 1,440	40%	$ 190	$ 1,250	$ 114	$ 386	3.4	6
J	$ 926	40%	$ 125	$ 801	$ 75	$ 245	3.3	5
	dollars in Millions							

Highest ranked project: H

Lowest ranked project: B

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I tested this portfolio of a sample of low to high risk, cost and value projects.

EV as a function of Relative Risk

Prospect Name	Gain (G)	Chance (Pc)	Cost (C)	Present Value (PV)	Relative Risk (RR)	Expected Value (EV)	Rating (RATE)	Rank
A	$ 1,107	24%	$ 177	$ 930	$ 135	$ 89	0.7	2
B	$ 542	18%	$ 72	$ 470	$ 59	$ 25	0.4	1
C	$ 129	76%	$ 47	$ 82	$ 11	$ 51	4.6	8
D	$ 2,333	28%	$ 146	$ 2,187	$ 105	$ 510	4.9	9
E	$ 1,464	20%	$ 147	$ 1,316	$ 117	$ 150	1.3	3
F	$ 356	60%	$ 104	$ 252	$ 42	$ 109	2.6	4
G	$ 96	93%	$ 70	$ 26	$ 5	$ 19	3.8	7
H	$ 1,540	45%	$ 140	$ 1,400	$ 77	$ 553	7.2	10
I	$ 1,440	40%	$ 190	$ 1,250	$ 114	$ 386	3.4	6
J	$ 926	40%	$ 125	$ 801	$ 75	$ 245	3.3	5
	dollars in Millions							

Highest ranked project: H

Lowest ranked project: B

Plotted on the next slide

note EV is on a log scale

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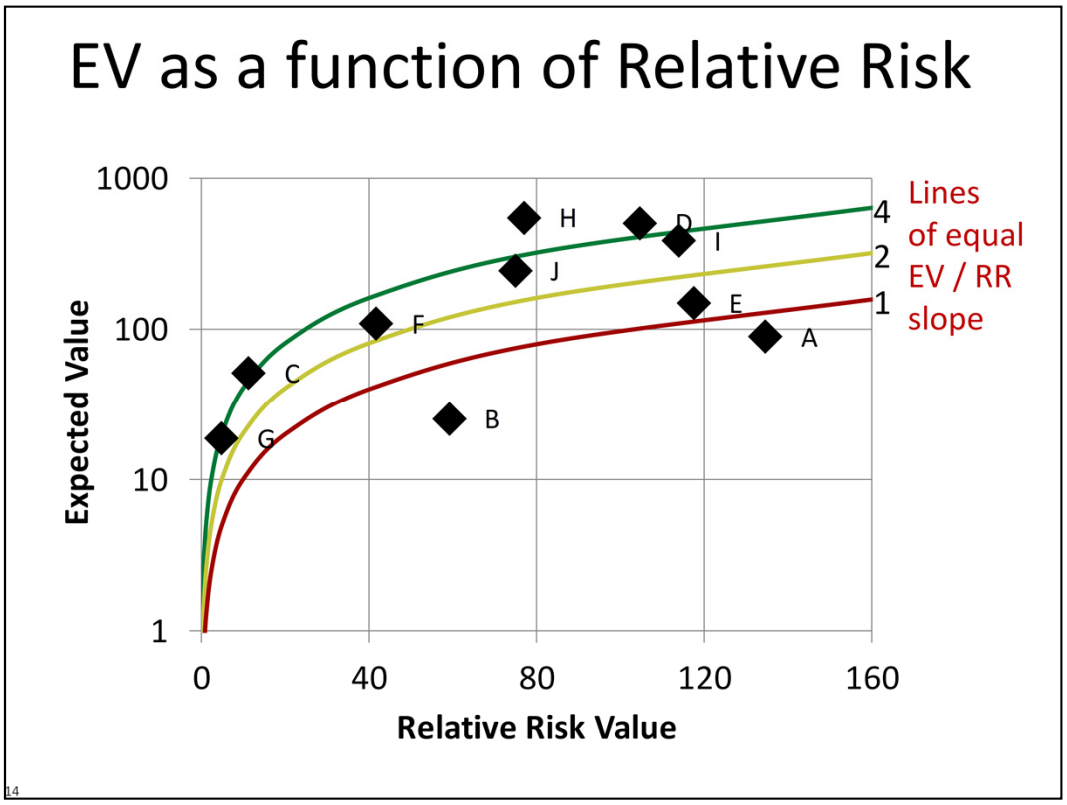
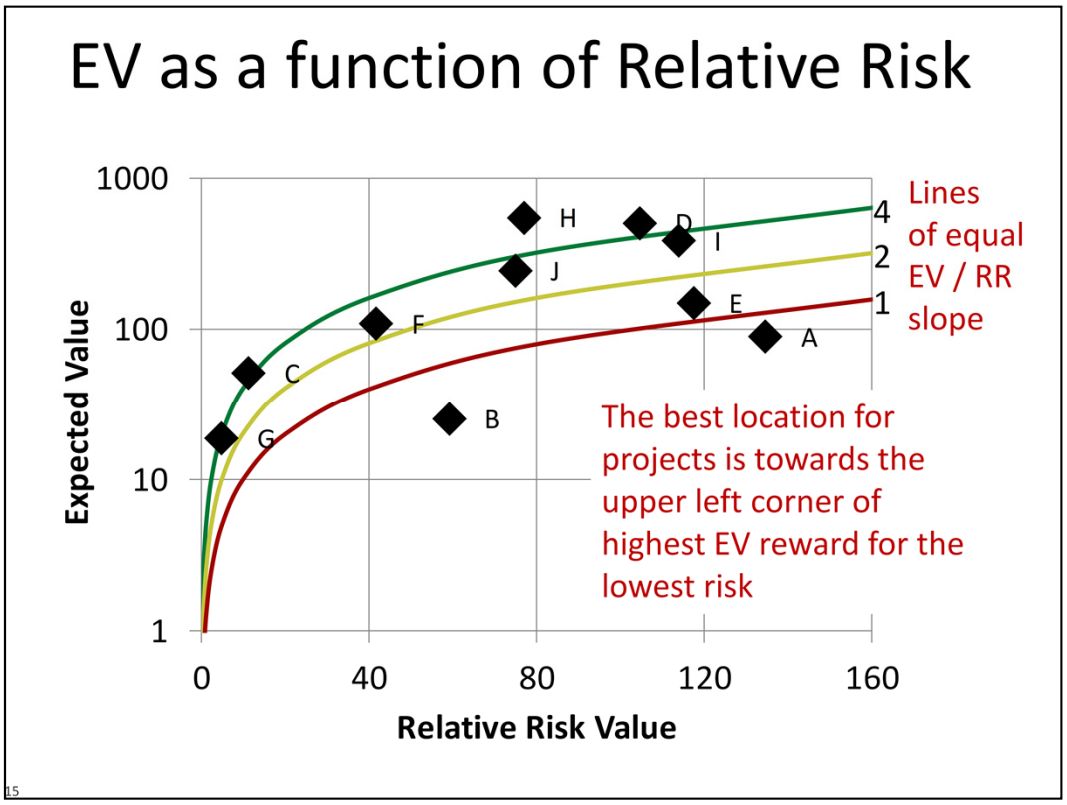
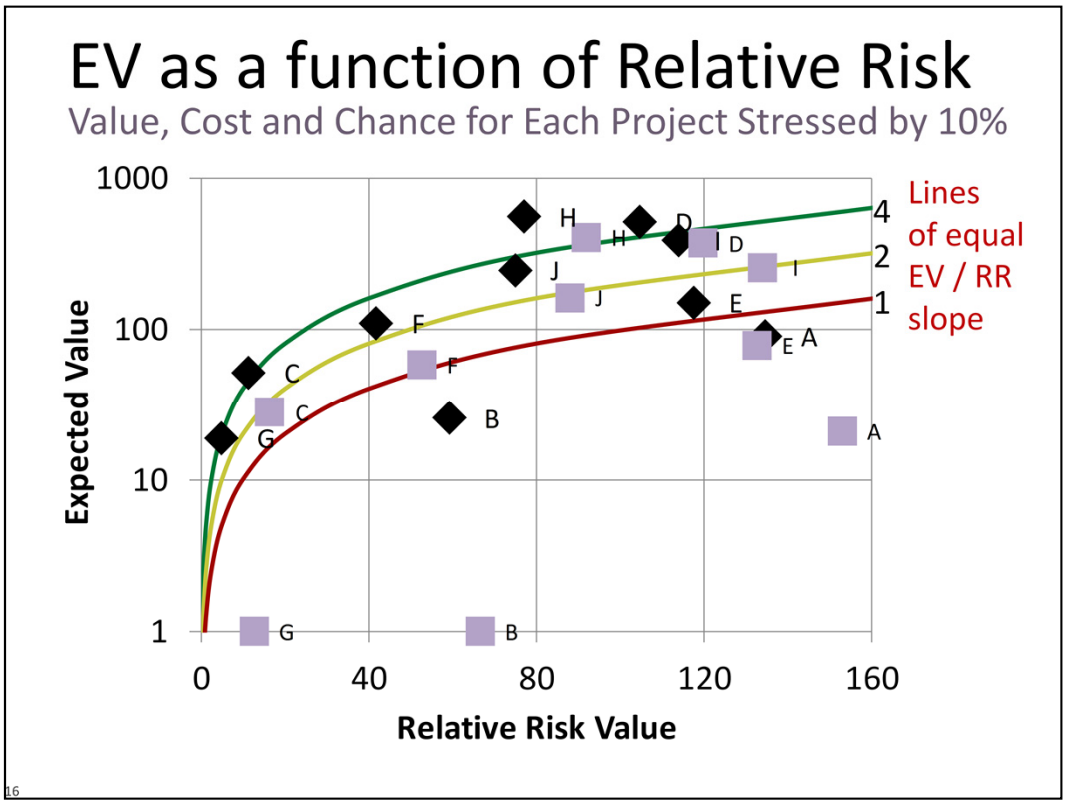
A forced rank will identify the best projects (with respect to this criteria) with high rank values seven through ten. I will nest plot the relative risk verses the expected value.



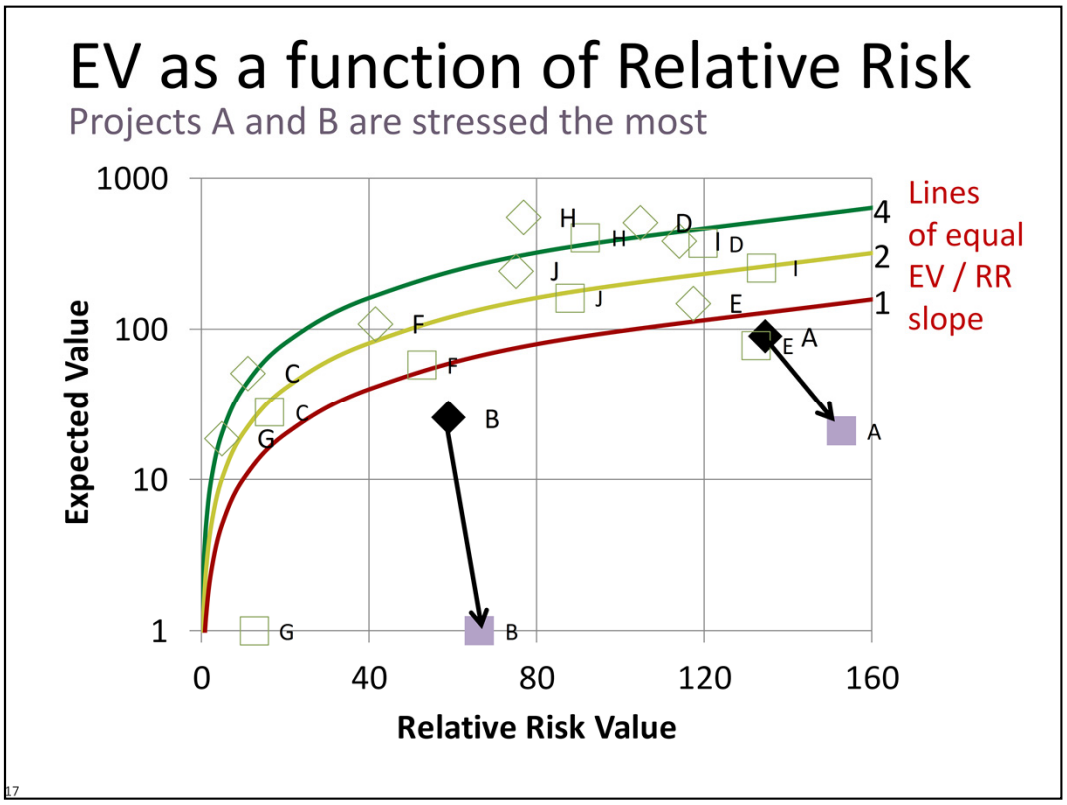
In general this plot is similar to an efficient frontier. The most efficient projects with respect to the tradeoff of these two criterion are along the green line. The green line represents a consistent tradeoff that results in a RATE value of 4. The portfolio had RATE values less than one to over four. In general, for this portfolio, above 2 is good and less than 2 is not so good. This is a relative rating an different RATE values may apply to different portfolios.



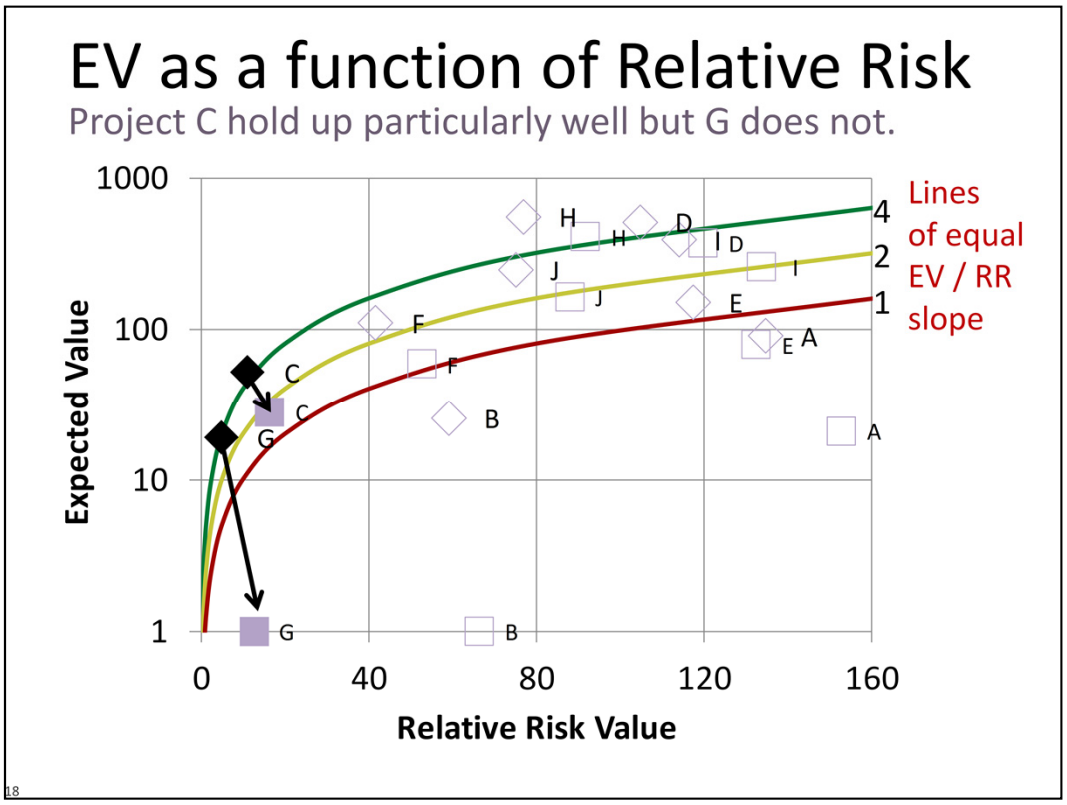
The best location for projects is towards the upper left corner of highest reward for the lowest risk.



All the projects will decline in rating with stress but some significantly more than others. The minimum expected value was set to 1 to avoid negative numbers on a log plot.



This is a look at the dramatic difference in change of performance for two of the less attractive projects.



This is a look at the dramatic difference in change of performance for two of the more attractive projects.

Stress Testing All Projects….

1. Projects can react differently to the same relative stress.
2. The reaction is not intuitive.
3. However, the reaction can be informative, and thus useful for decision makers.

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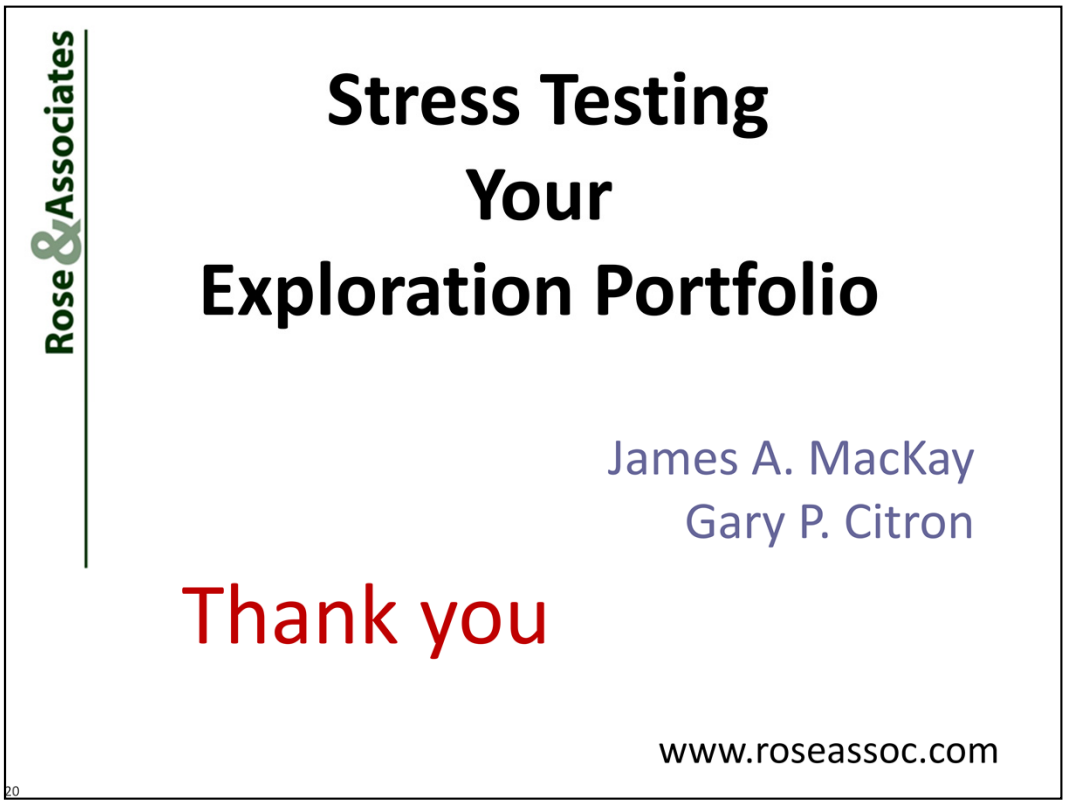
The point is to be aware of the projects that are more sensitive to uncertainty.



The speaker, James MacKay, can be contacted at jamesmackay@roseassoc.com

References cited in the manuscript.

- MacKay, James A., 2015, Comparing the Results of the Kelly Criterion and Risk Aversion: Quick Look Practical Alternatives to Portfolio Optimization. GCAGS Transactions (2015) Vol. 65, pp. 273-280.
- Schmieder, C., Puhr, C. and Hasan, M., 2011, Next Generation Balance Sheet Stress Testing. International Monetary Fund WP/11/83, April, 2011 http://www.imf.org/external/pubs/ft/wp/2011/wp1183.pdf accessed March 7, 2016.
- Rose, Peter R., Delfiner, P., and Longmuir, G., 2004, Chronic E&P Underperformance: Is Dennis Horner's 'Inevitable Disappointment' Portfolio Model Really Inevitable? Presentation to the AAPG International Annual Convention, Cancun.
- Vaughan, Rory, 2008, Stress Testing and Scenario Testing, Financial Services Authority 2008 http://www.fsa.gov.uk/pubs/cp/cp08_24.pdf accessed March 7, 2016.