

From Qualitative towards Quantitative Assessment in Risk Management

Extending System Safety Frontiers

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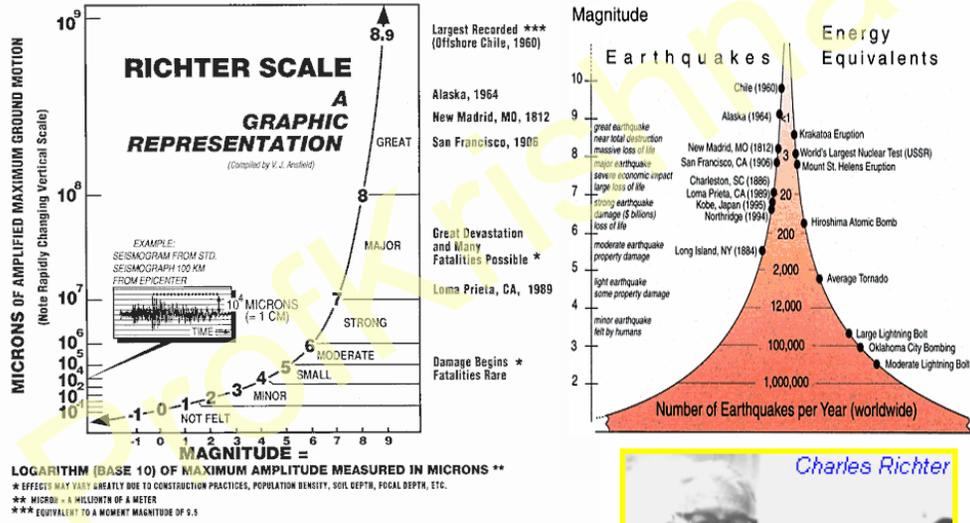
A simple solution with simple terms

- Figure depicts how 'Least' (or 'Lowest') and 'Most' (or 'Highest') will define the span for any of the variables, and how with the simple addition of words 'Low' and 'High' and the adjective 'Very' the span can go from 3 to 5 to 7 levels.
- For even numbers, 'Medium' may be omitted as a convention, retaining symmetry of wording.

3 Levels		Least	Medium	Most			
4 Levels		Least	Low	High	Most		
5 Levels		Least	Low	Medium	High	Most	
6 Levels	Least	Very Low	Low	High	Very High	Most	
7 Levels	Least	Very Low	Low	Medium	High	Very High	Most

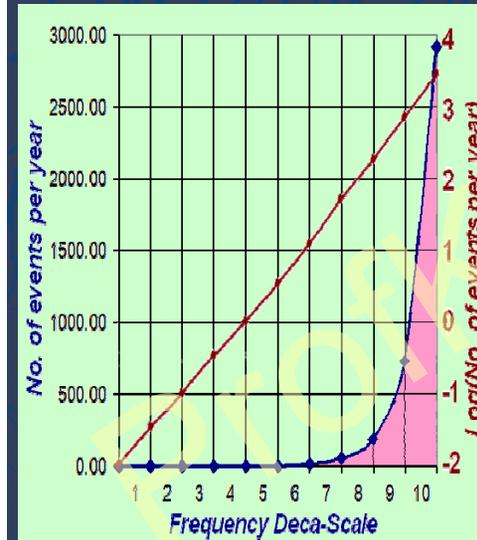


The Richter Scale for earthquakes



The Torino scale for asteroid impact

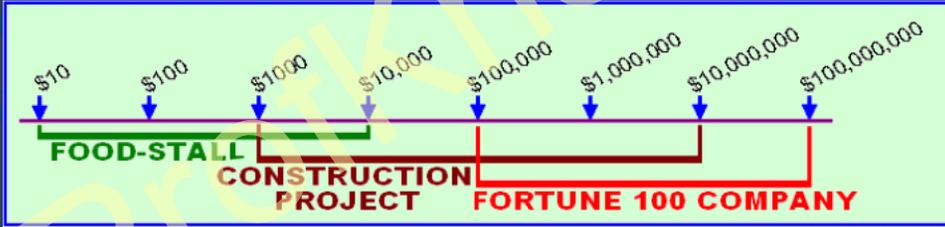
- This is akin to our likelihood scale for risk



THE TORINO SCALE		
Assessing Asteroid/Comet Impact Predictions		
No Hazard	0	The likelihood of collision is zero, or is so low as to be effectively zero. Also applies to small objects such as meteors and bolides that burn up in the atmosphere as well as infrequent meteorite falls that rarely cause damage.
Normal	1	A routine discovery in which a pass close to the Earth is predicted that poses no unusual level of danger. Current calculations indicate the likelihood of collision is extremely unlikely with no cause for public attention. No public concern. Here telescopic observations very likely will lead to re-assignment to Level 0.
Meriting Attention by Astronomers	2	A discovery which may become routine with expanded searches, of an object making a somewhat close but not highly unusual pass near the Earth. While meriting attention by astronomers, there is no cause for public attention or public concern as an actual collision is very unlikely. New telescopic observations very likely will lead to re-assignment to Level 0.
	3	A close encounter, meriting attention by astronomers. Current calculations give a 1% or greater chance of collision capable of localized destruction. Most likely, new telescopic observations will lead to re-assignment to Level 0. Attention by the public and by public officials is merited if the encounter is less than a decade away.
Threatening	4	A close encounter, meriting attention by astronomers. Current calculations give a 1% or greater chance of collision capable of regional devastation. Most likely, new telescopic observations will lead to re-assignment to Level 0. Attention by the public and by public officials is merited if the encounter is less than a decade away.
	5	A close encounter posing a serious, but still uncertain threat of regional devastation. Critical attention by astronomers is needed to determine conclusively whether or not a collision will occur. If the encounter is less than a decade away, governmental contingency planning may be warranted.
	6	A close encounter by a large object posing a serious, but still uncertain threat of a global catastrophe. Critical attention by astronomers is needed to determine conclusively whether or not a collision will occur. If the encounter is less than a decade away, governmental contingency planning may be warranted.
Certain Collisions	7	A very close encounter by a large object, which if occurring this century, poses an unprecedented but still uncertain threat of a global catastrophe. For such a threat in this century, international contingency planning is warranted, especially to determine urgently and conclusively whether or not a collision will occur.
	8	A collision is certain, capable of causing localized destruction for an impact over land or possibly a tsunami if close offshore. Such events occur on average between once per 10 years and once per several 1000 years.
	9	A collision is certain, capable of causing unprecedented regional devastation for a land impact or the threat of a major tsunami for an ocean impact. Such events occur on average between once per 10,000 years and once per 100,000 years.
	10	A collision is certain, capable of causing a global climatic catastrophe that may threaten the future of civilization as we know it, whether impacting land or ocean. Such events occur on average once per 100,000 years, or less often.

- This is akin to our severity scale for risk.

nk Range and span ... examples



❖ Example: If the hospital stay and treatment for a particular injury varies from 1 day to 1 year, but an assessor wishes to cover only stays between 3 days to 3 months, then the range is 1 to 365, and the span is 3 to 91, both in days.

nk The injury Deca-Scale

nk Important considerations

- ❖ Currency values may historically and geographically vary very widely. Long-term global strategy may be to take a basic cost of living unit like a loaf of bread.
- ❖ Natural disasters, and events happening once in thousands of years are beyond our control. Leave them to specialised think-tanks in rich countries.
- ❖ If the controls for different hazard factors are different, they should be kept separate till the end. Otherwise, a straight average of the multiple values, or better, a weighted average leaning towards higher value(s) may be adequate.
- ❖ There may be no violation of basic concept in multiplying fractional averages to find the risk, as that would preserve original assumptions intact instead of worsening them. With severity 5.3 and likelihood 2.5, risk = $5.3 \times 2.5 = 13.25 \rightarrow 13$.

nk Sub-set risk matrix for office

Lkl Sev	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
S10	10	20	30	40	50	60	70	80	90	100
S9	9	18	27	36	45	54	63	72	81	90
S8	8	16	24	32	40	48	56	64	72	80
S7	7	14	21	28	35	42	49	56	63	70
S6	6	12	18	24	30	36	42	48	54	60
S5	5	10	15	20	25	30	35	40	45	50
S4	4	8	12	16	20	24	28	32	36	40
S3	3	6	9	12	15	18	21	24	27	30
S2	2	4	6	8	10	12	14	16	18	20
S1	1	2	3	4	5	6	7	8	9	10