PREMIUM ALLOCATION
VISUAL EXAMPLES

Aspen Insurance

11th March 2021

Adam Casselman

Pooling of Risks

The basic principle of insurance is that the losses of the few are met by the contributions of the many.

An insurance company operates a common pool. Contributions, in the form of premiums from all those insured, go into this pool.

Out of the pool come payments to compensate the losses of the few.

Premiums must be large enough in total to meet the losses, the costs of operating the pool and an element of profit.

The insurer endeavours to make sure that the premium each insured pays is equitable in relation to the risk that they introduce to the pool.

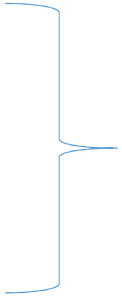
Premium Rates

- Claims
  - Attrition
  - Large Losses
  - Natural Catastrophe
- Cost of Capital
- Expenses
- Reinsurance costs
- Profit
- Commissions

- Influenced by supply and demand during the market cycle
- Different for each insurance company
- Different year-by-year
- There is no ‘correct’ rate

Premium Rates

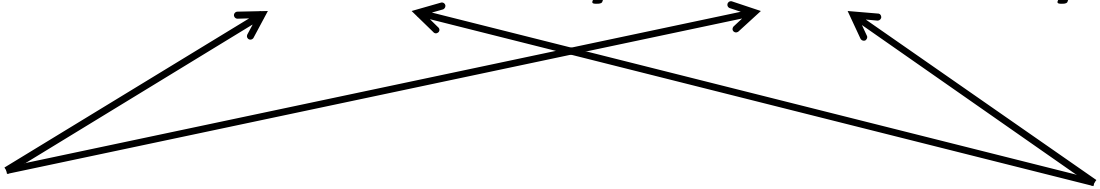
- Claims
  - Attrition
  - Large Losses
  - Natural Catastrophe
- Cost of Capital
- Expenses
- Reinsurance costs
- Profit
- Commissions



- The claims component of premium is derived from risk
- Risk is the same for all insurers who cover a project at the same policy terms and conditions

Risk

Risk = Probability x Severity



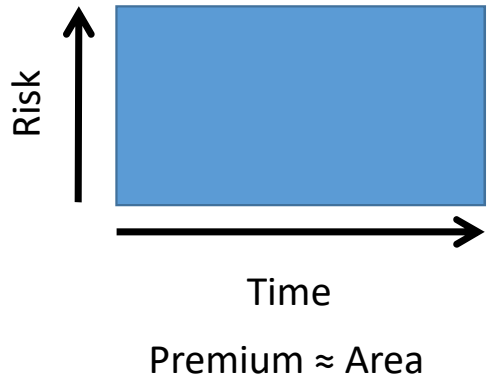
- Volume of activities
- Type of activities

- Amount of property exposed
- Vulnerability of property exposed

Area Analogy

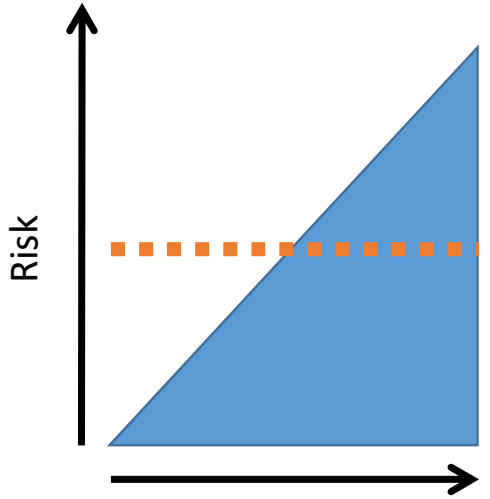
Premium is directly proportional to risk.

Uniform risk:



Premium ≈ Area

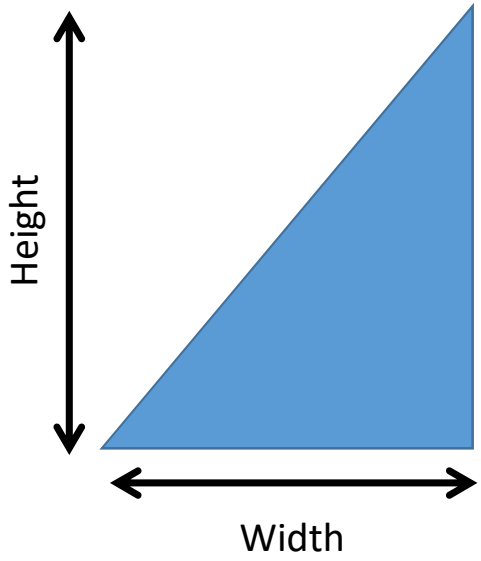
Construction risk:



Premium ≈ Area

Triangles vs S-Curves

- Triangles are easy to visualise and calculate area vs S-Curves:



Area = ½ x Height x Width

VS

A **logistic function** or **logistic curve** is a common S-shaped curve (sigmoid curve) with equation

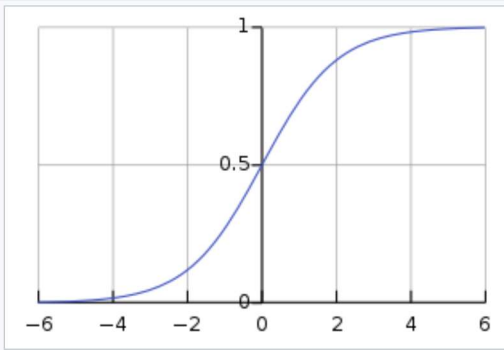
$$f(x) = \frac{L}{1 + e^{-k(x - x_0)}},$$

where

x_0, the x value of the sigmoid's midpoint;

L, the curve's maximum value;

k, the logistic growth rate or steepness of the curve.[1]



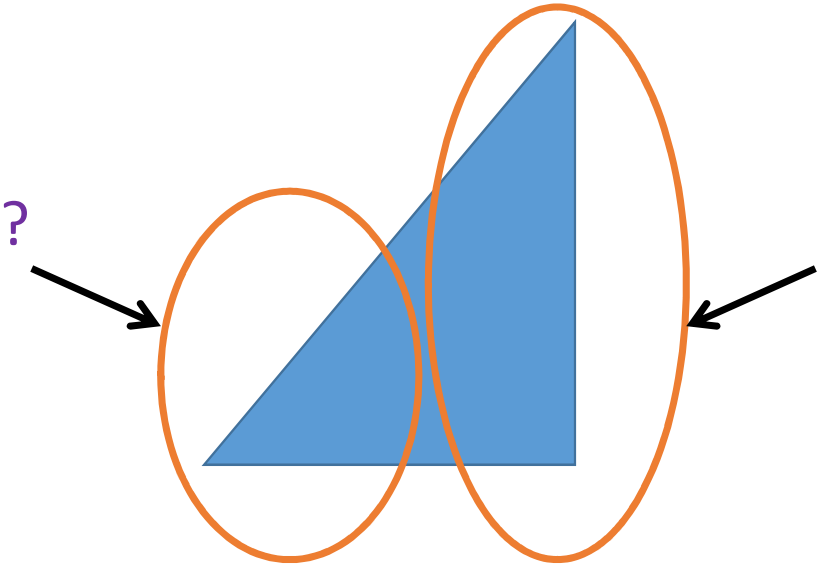
Standard logistic sigmoid function i.e. $L = 1, k = 1, x_0 = 0$

Area = $\int f(x)$

Risk Over Time

Early in the period
=
lower risk

- Lower value at risk
- Less risky activities?
- Fewer high value materials
- More options to deviate from plan



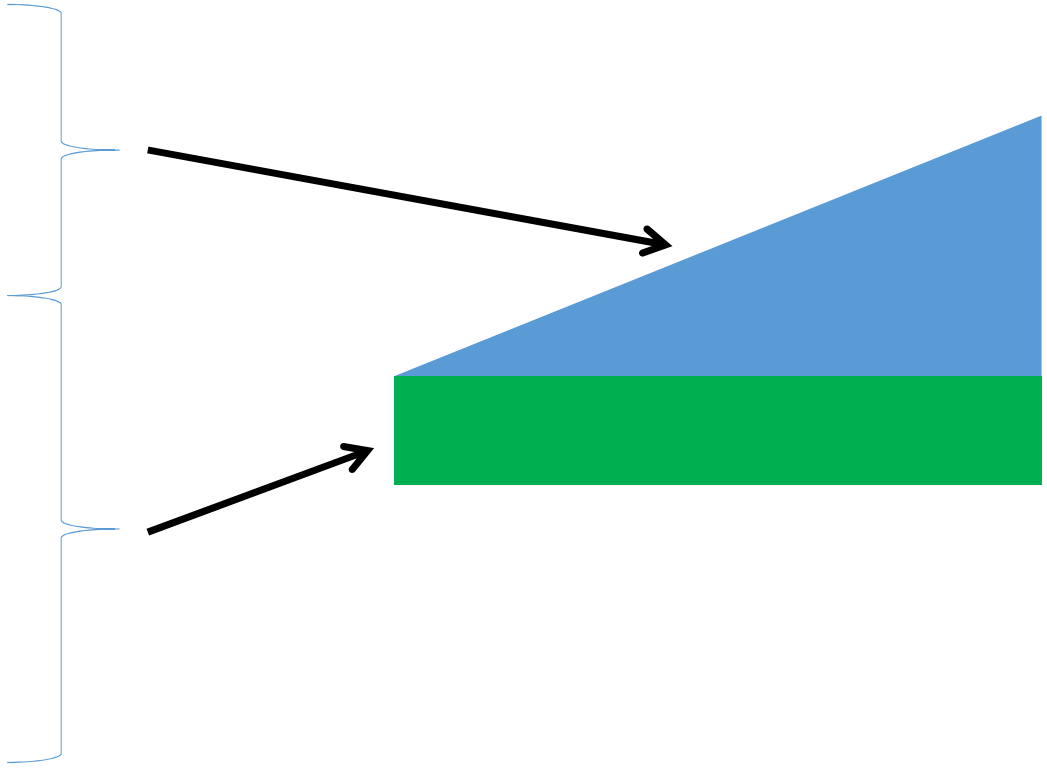
Late in the period
=
higher risk

- Higher value at risk
- More risky activities?
- High value / more vulnerable items
- Few options to deviate from plan

Risk = Probability x Severity

Premium Rates

- Claims
  - Attrition
  - Large Losses
  - Natural Catastrophe
- Cost of Capital
- Expenses
- Reinsurance costs
- Profit
- Commissions

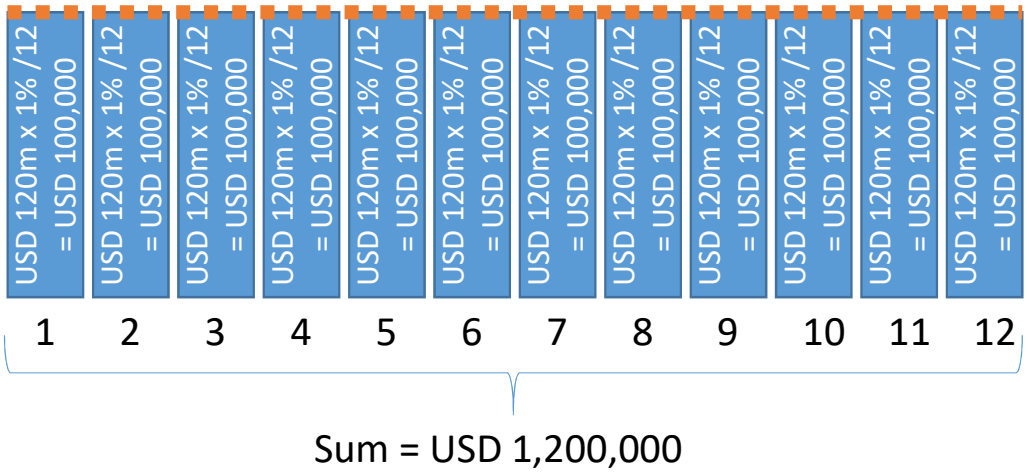


Key Points

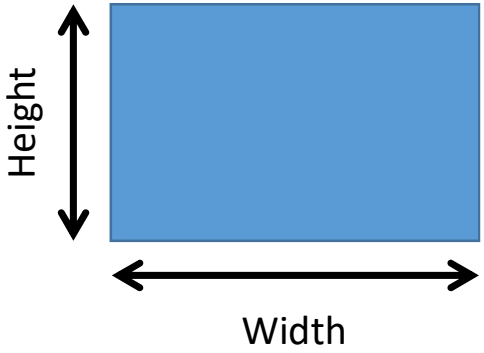
- There is no ‘correct’ rate
- Premiums are made up of different components
- Some components are uniform and do not directly depend on risk
- Components which are derived from risk can change over time
- Risk usually increases with time for construction projects
- It is equitable for an insured to pay more premium to remain in the pool longer as they represent a risk to the pool for longer
- Even if the insured has had no losses, their premium is required within the pool to pay the losses of the pool whose protection they benefit from

Premium ≈ Area (Uniform Risks)

1% rate applied to USD 120m completed building for 12 month period:



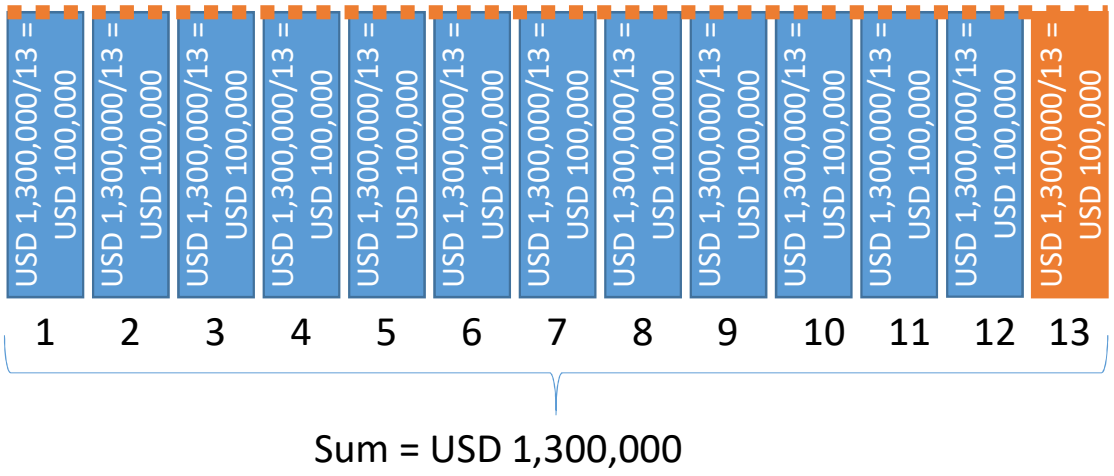
Month	Premium
1	100,000
2	100,000
3	100,000
4	100,000
5	100,000
6	100,000
7	100,000
8	100,000
9	100,000
10	100,000
11	100,000
12	100,000
TOTAL	1,200,000



Area = Height x Width

Pro Rata = Average

Example: One month extension at pro-rata AP:



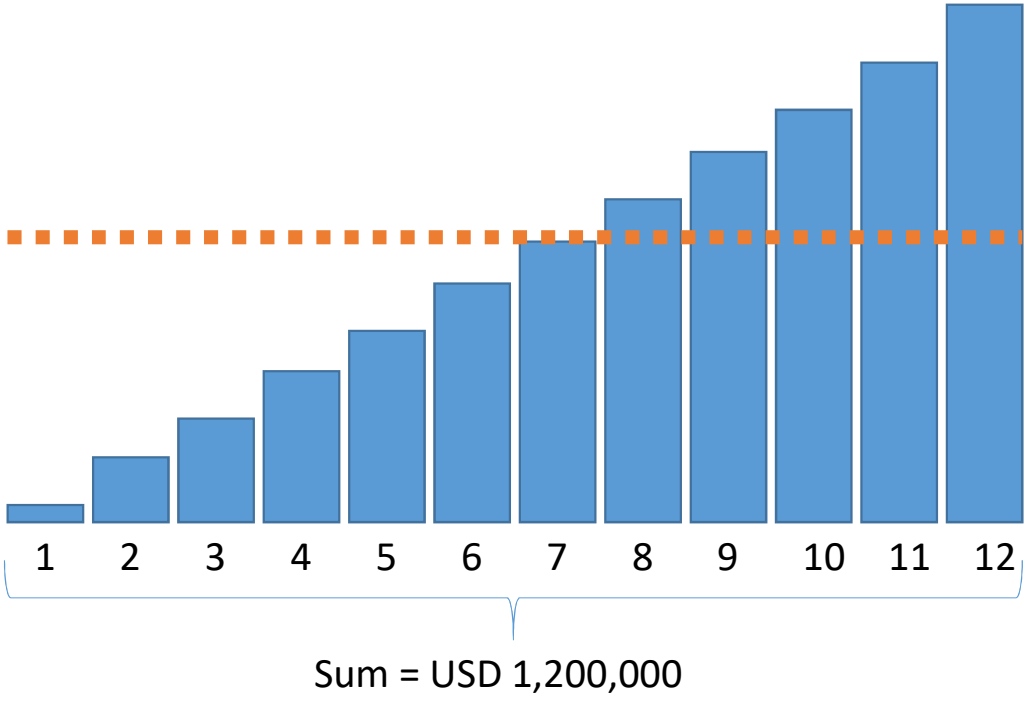
Month	Premium
1	100,000
2	100,000
3	100,000
4	100,000
5	100,000
6	100,000
7	100,000
8	100,000
9	100,000
10	100,000
11	100,000
12	100,000
13	100,000
TOTAL	1,300,000

Pro-rata = Average

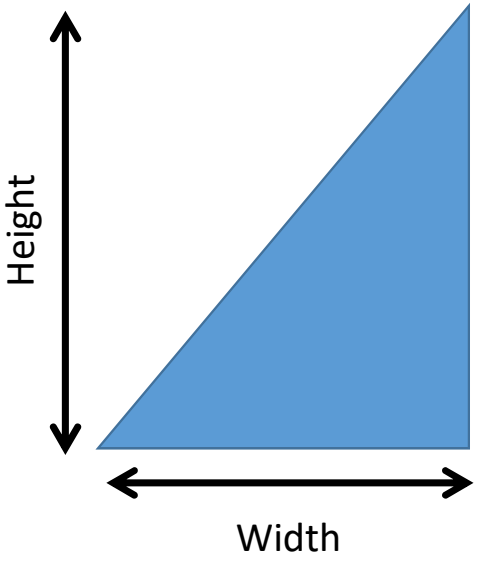
Pro-rata is equitable if risk does not change over time.

Premium ≈ Area (Construction Risks)

1% rate applied to USD 120m construction project for 12 month period:



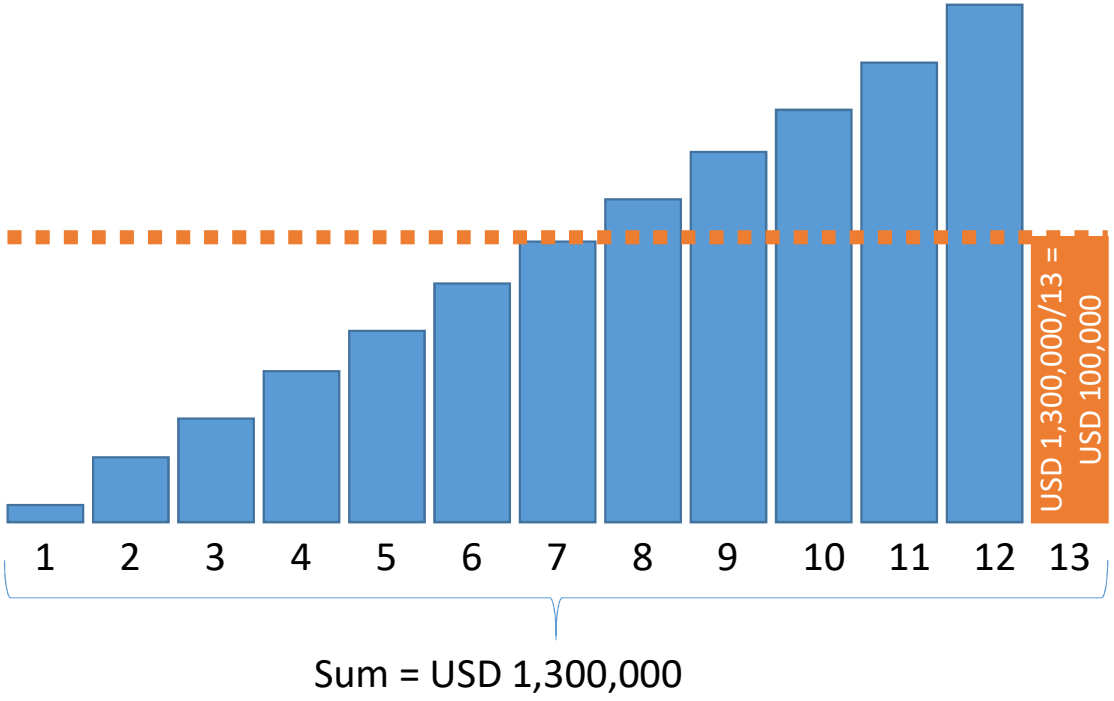
Month	Premium
1	10,000
2	25,000
3	40,000
4	55,000
5	70,000
6	85,000
7	100,000
8	120,000
9	140,000
10	160,000
11	180,000
12	200,000
TOTAL	1,200,000



Area = ½ x Height x Width

Pro Rata = Average

Example: One month extension at pro-rata AP:



Month	Premium
1	10,000
2	25,000
3	40,000
4	55,000
5	70,000
6	85,000
7	100,000
8	120,000
9	140,000
10	160,000
11	180,000
12	200,000
13	100,000
TOTAL	1,300,000

Pro-rata = Average

Pro-rata may not be equitable if risk changes over time.

Key Points

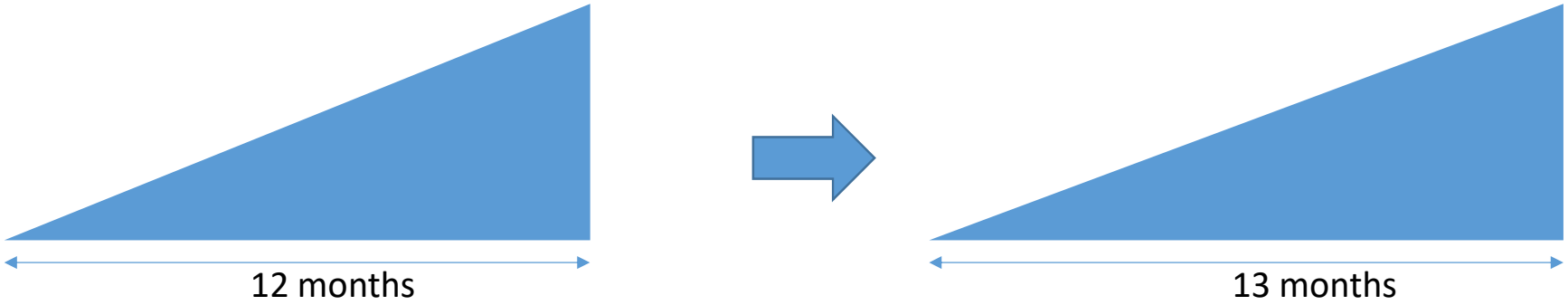
- Completed property or operational risks are often uniform, i.e. they represent an equal risk to the pool every month of the policy period
- Period extensions at pro rata AP can be equitable for uniform risks
- The risk a construction project represents to the pool is variable and usually increases as it progresses
- The premium should be allocated over the policy period in line with the increase in risk
- The premium rate for a construction risk is an average over the period and does not represent the risk associated with any one part of the policy period

Period Extensions

- Example 1: Risk builds up more slowly than originally planned
- Example 2: Risk incepts but works not started straight away
- Example 3: Risk delayed early on in the project
- Example 4: Risk builds up as originally planned but delayed in handing over

Example 1

Risk builds up more slowly than originally planned:



Premium ≈ Area

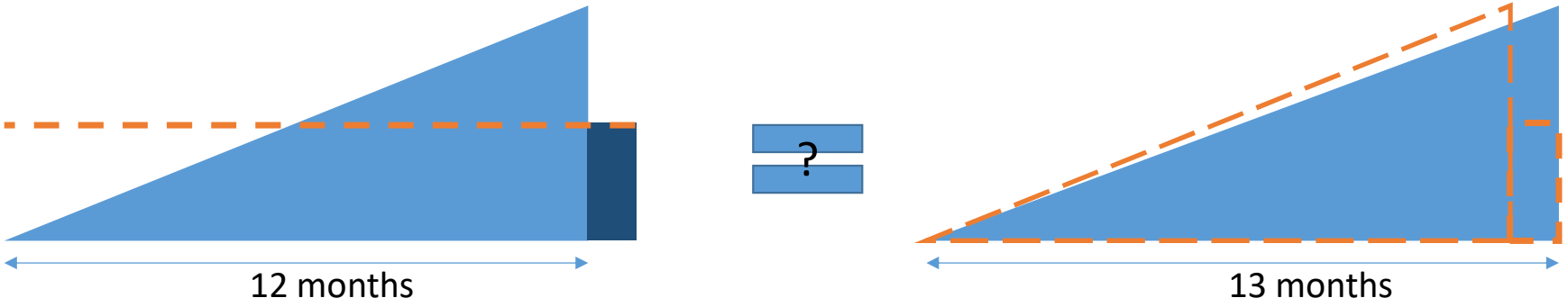
Premium = USD 1,200,000

Premium ≈ Area

Premium = ?

Example 1

Risk builds up more slowly than originally planned:

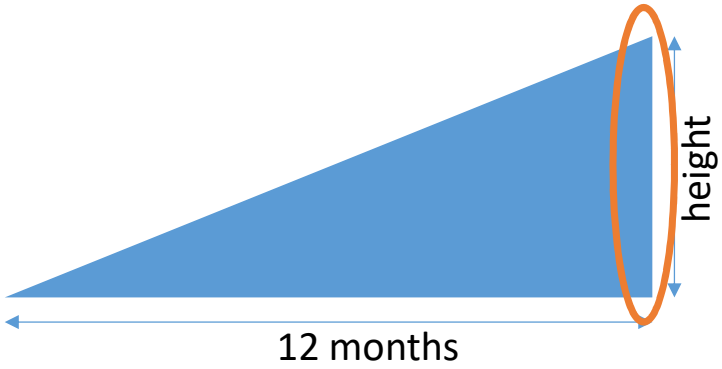


Pro Rata Premium = USD 1.2m + USD 100,000
= USD 1,300,000

Does pro rata work?

Example 1

Risk builds up more slowly than originally planned:

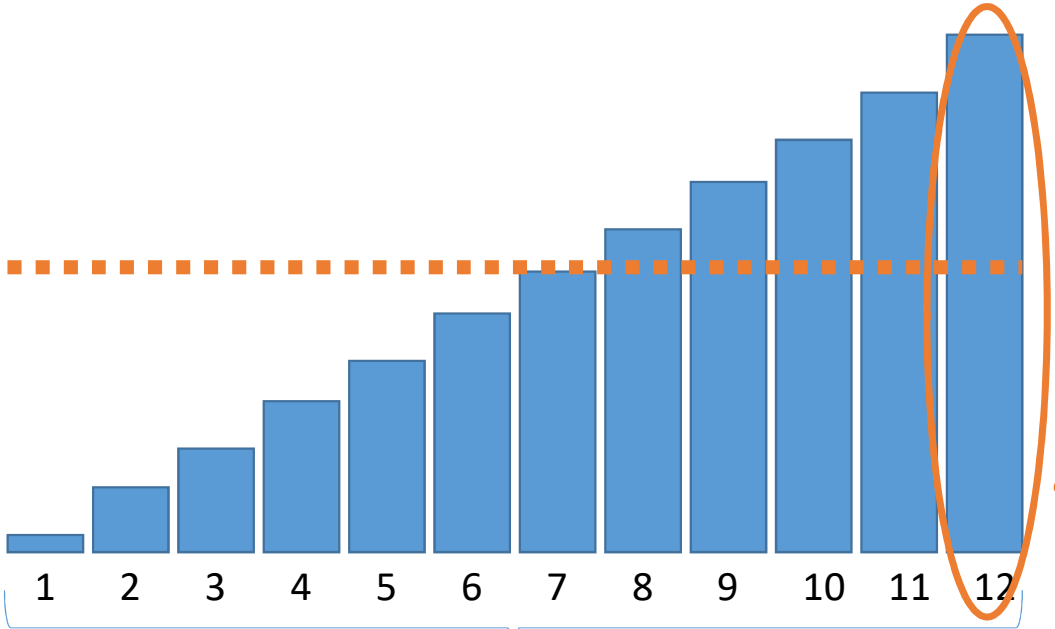


Premium = USD 1,200,000
Area ≈ Premium
½ width x height = USD 1,200,000
½ x 12 x height = USD 1,200,000
height = USD 200,000

Height ≈ final month's premium, representing full exposure to the pool

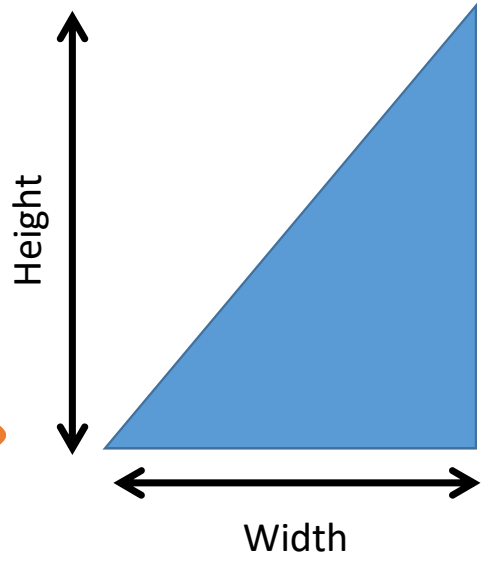
Example 1

1% rate applied to USD 120m construction project for 12 month period:



Sum = USD 1,200,000

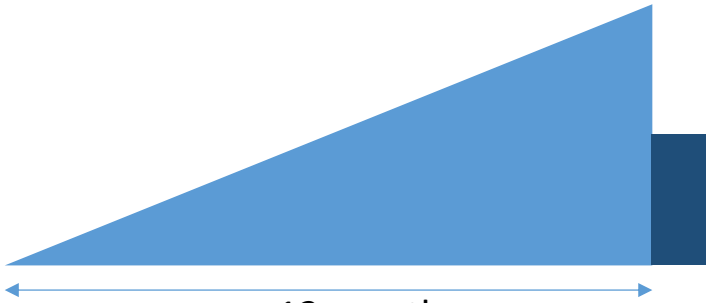
Month	Premium
1	10,000
2	25,000
3	40,000
4	55,000
5	70,000
6	85,000
7	100,000
8	120,000
9	140,000
10	160,000
11	180,000
12	200,000
TOTAL	1,200,000

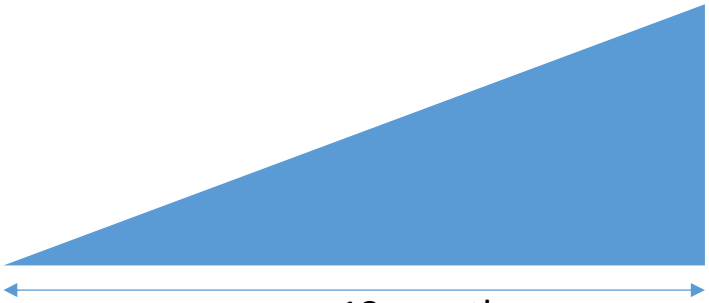


Area = ½ x Height x Width

Example 1

Risk builds up more slowly than originally planned:





Pro Rata Premium = USD 1.2m + USD 100,000
= USD 1,300,000

Premium ≈ Area
Premium = ½ x width x height
= ½ x 13 x USD 200,000
= USD 1,300,000

Key Points

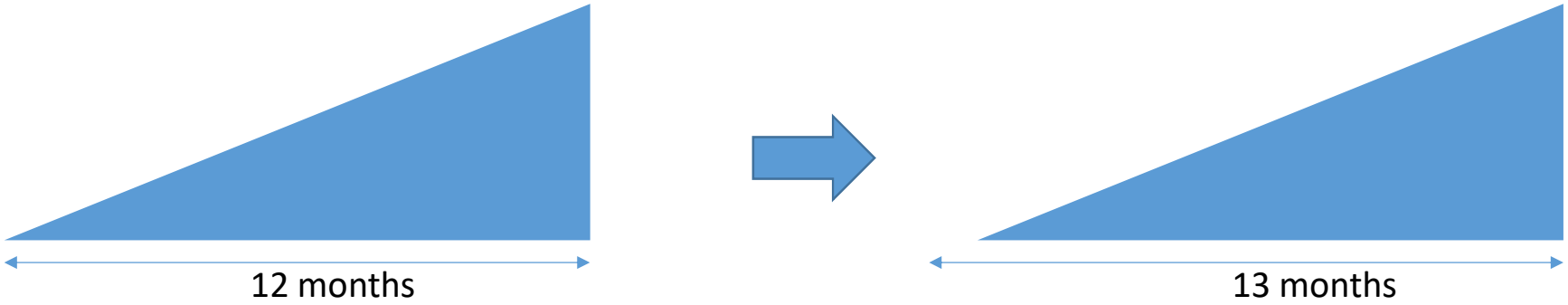
- Period Extensions at pro rata may be equitable to the pool if the project risk builds up more slowly than originally anticipated
- It is not always obvious or intuitive when pro-rata is equitable and when it is not

BUT

- Risk may be elevated as the insured parties try to make up for the delay

Example 2

Risk incepts but works not started straight away:



Premium ≈ Area

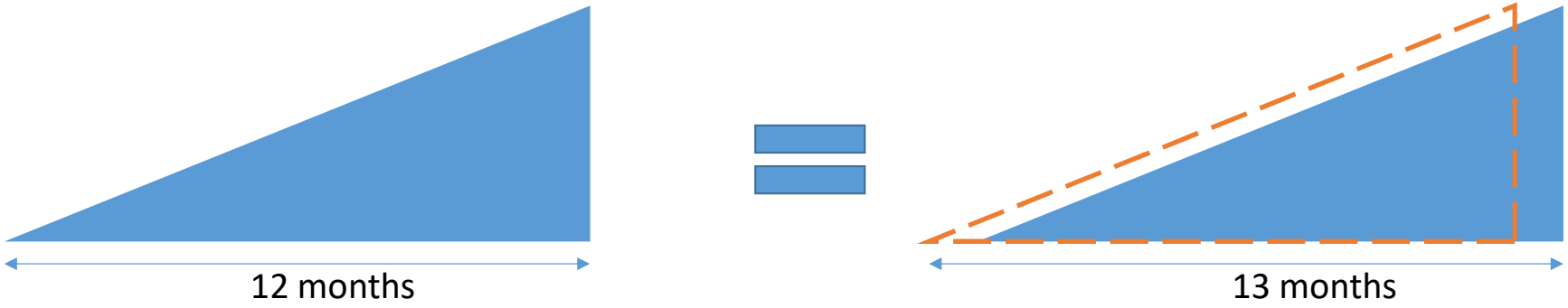
Premium = USD 1,200,000

Premium ≈ Area

Premium = ?

Example 2

Risk incepts but works not started straight away:



Premium ≈ Area

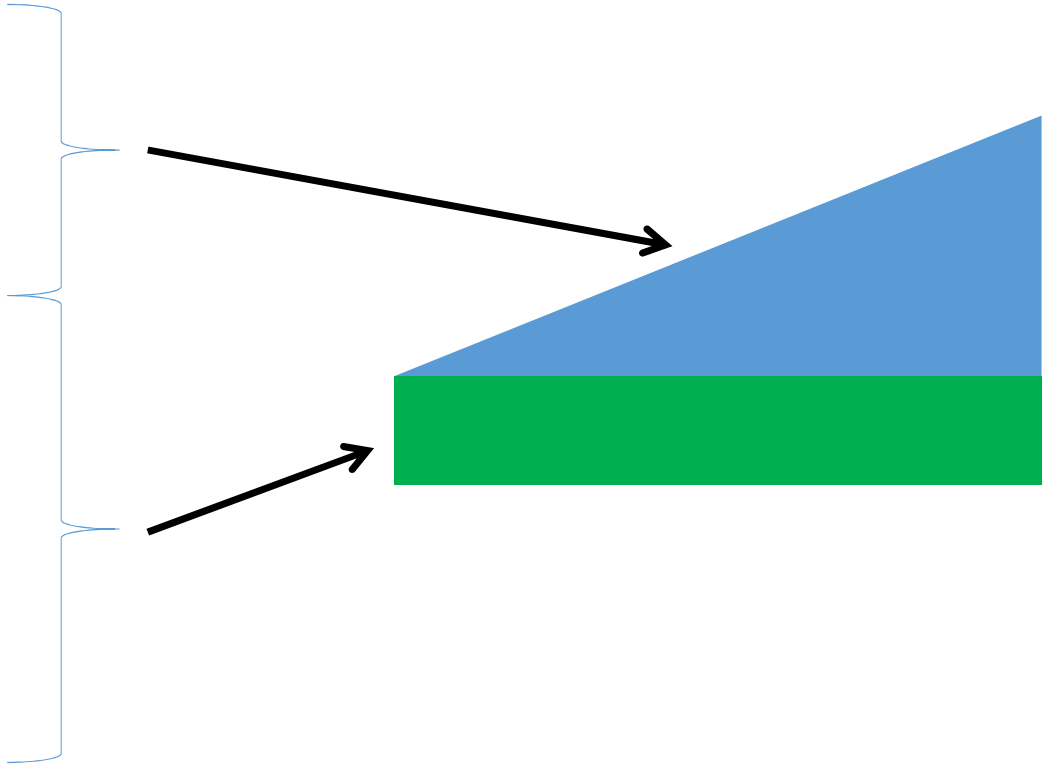
Premium = USD 1,200,000

Premium ≈ Area

Premium = 1,200,000

Example 2

- Claims
  - Attrition
  - Large Losses
  - Natural Catastrophe
- Cost of Capital
- Expenses
- Reinsurance costs
- Profit
- Commissions

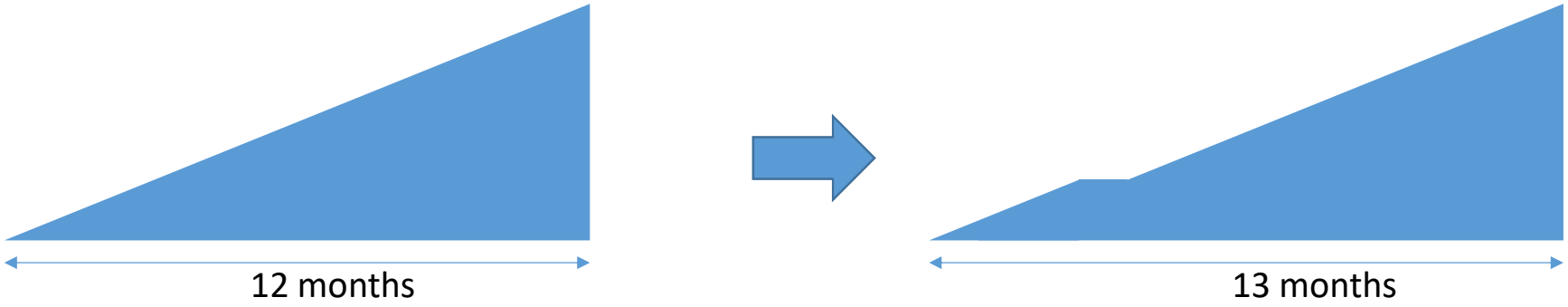


Key Points

- The project represents no risk to the insurer during the delay
- Insurers reserve capital and incur costs for all live policies
- Insurers incur these costs independent of risk
- Pro rata AP is probably too high, but nil AP is definitely too low to cover the costs incurred
- It is equitable to the pool for the insured to cover the costs incurred in maintaining their policy
- Risk may be elevated as the insured parties try to make up for the delay

Example 3

Risk delayed early on in the project:



Premium ≈ Area

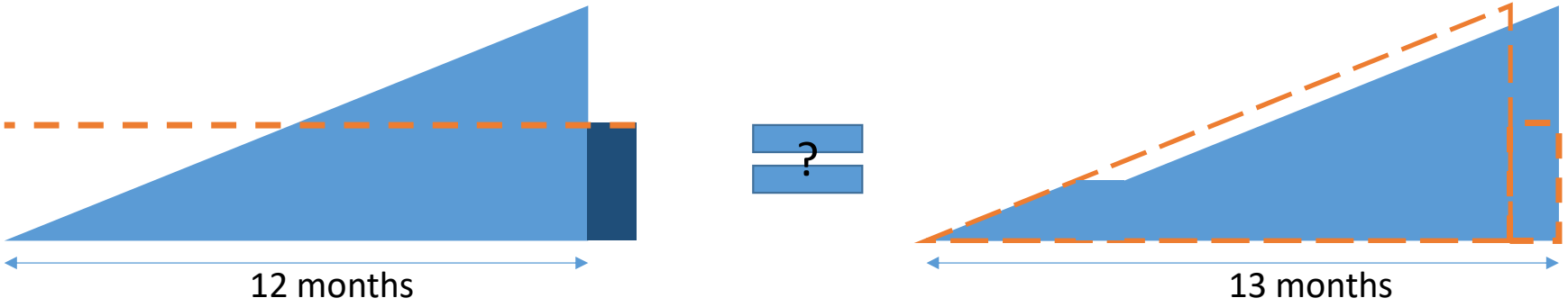
Premium = USD 1,200,000

Premium ≈ Area

Premium = ?

Example 3

Risk delayed early on in the project:

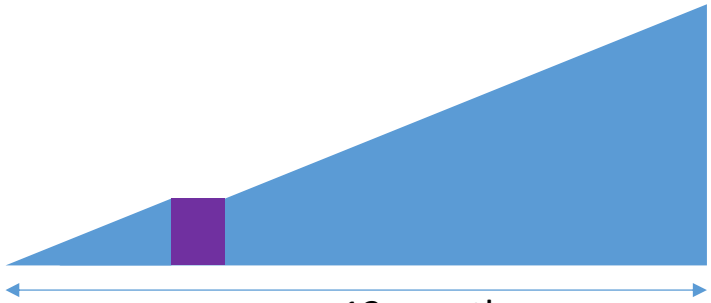


Pro Rata Premium = USD 1.2m + USD 100,000
= USD 1,300,000

Does pro rata work?

Example 3

Risk delayed early on in the project:

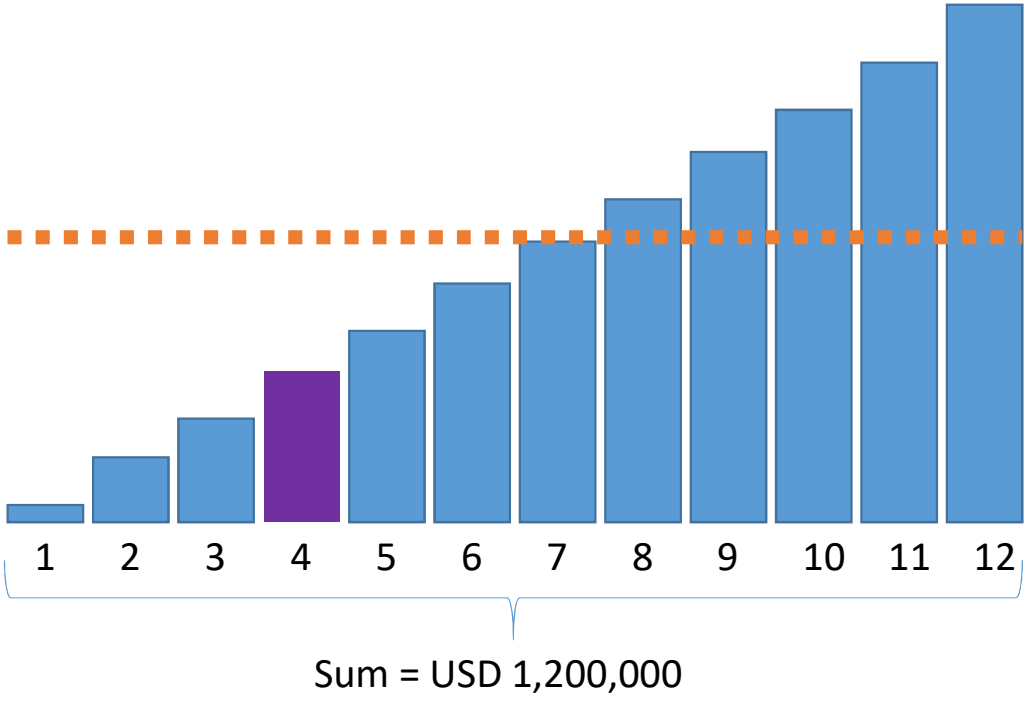


Premium ≈ Area

Premium = USD 1,200,000 +

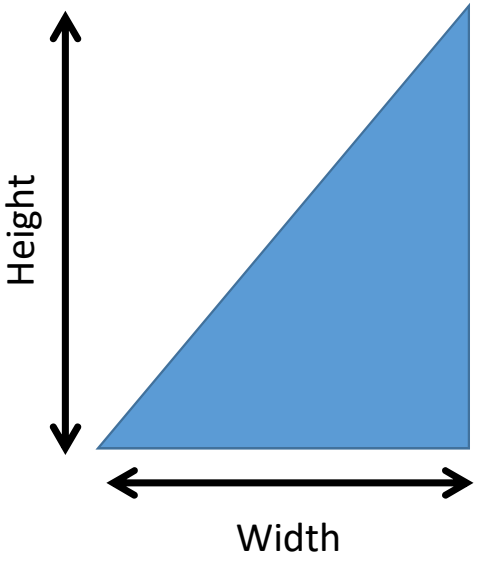
Example 3

1% rate applied to USD 120m construction project for 12 month period:



Sum = USD 1,200,000

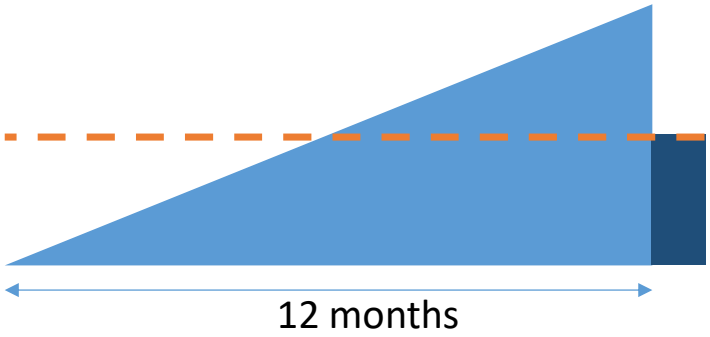
Month	Premium
1	10,000
2	25,000
3	40,000
4	55,000
5	70,000
6	85,000
7	100,000
8	120,000
9	140,000
10	160,000
11	180,000
12	200,000
TOTAL	1,200,000

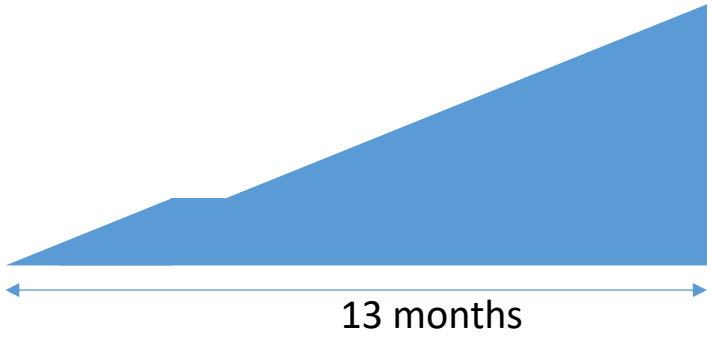


Area = ½ x Height x Width

Example 3

Risk delayed early on in the project:





Pro Rata Premium = USD 1.2m + USD 100,000
= USD 1,300,000

Premium ≈ Area

Premium = USD 1.2m + USD 55,000
= USD 1,255,000

Key Points

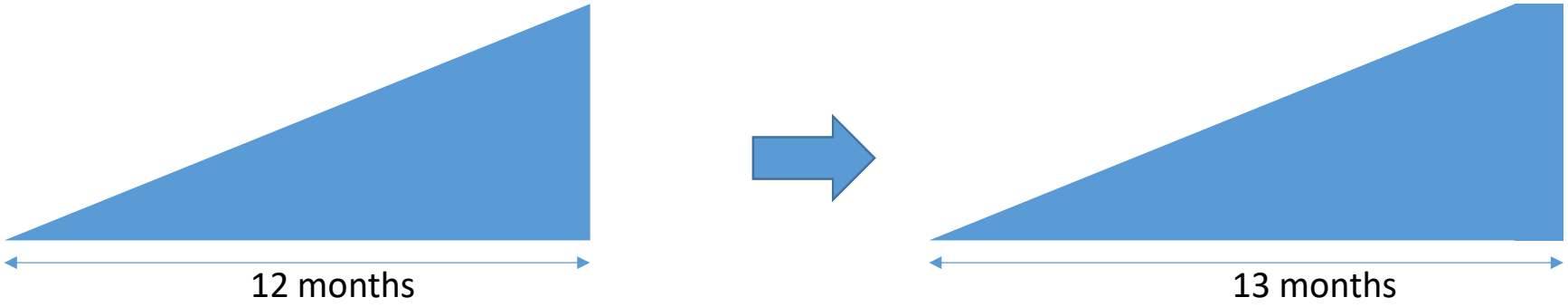
- Period Extensions at less than pro rata may be equitable to the pool if the project risk during the extension period is lower than the average over the whole period

BUT

- Risk may be elevated as the insured parties try to make up for the delay

Example 4

Risk builds up as originally planned but delayed in handing over:



Premium ≈ Area

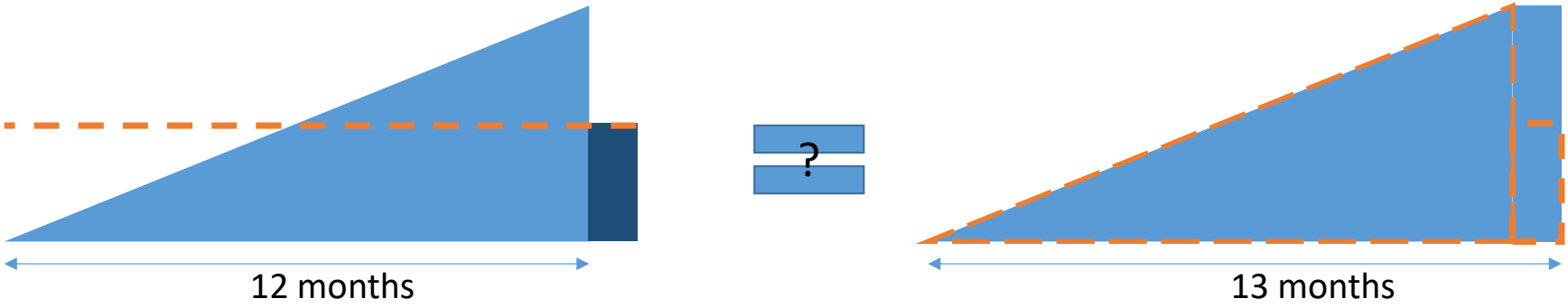
Premium = USD 1,200,000

Premium ≈ Area

Premium = ?

Example 4

Risk builds up as originally planned but delayed in handing over:

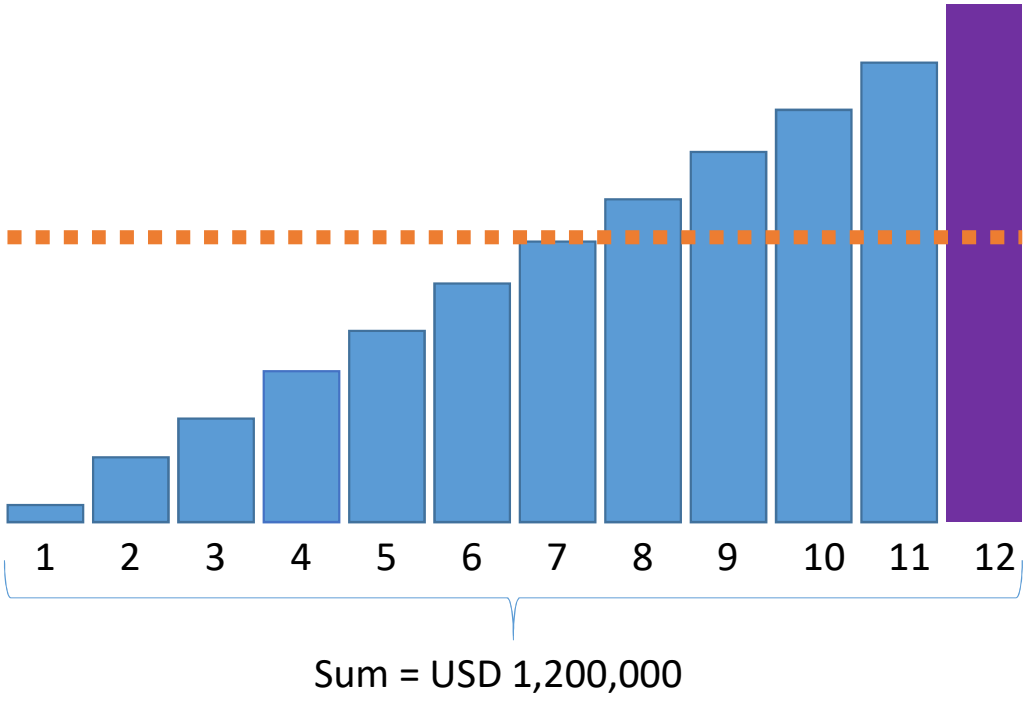


Pro Rata Premium = USD 1.2m + USD 100,000
= USD 1,300,000

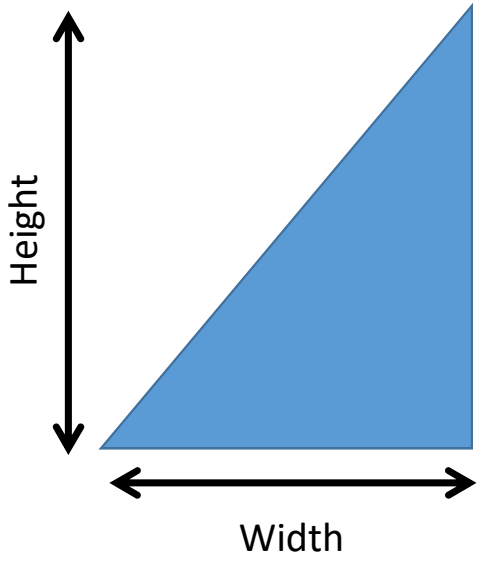
Does pro rata work?

Example 4

1% rate applied to USD 120m construction project for 12 month period:



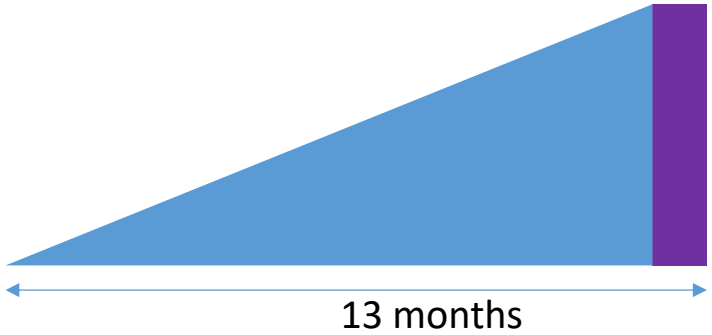
Month	Premium
1	10,000
2	25,000
3	40,000
4	55,000
5	70,000
6	85,000
7	100,000
8	120,000
9	140,000
10	160,000
11	180,000
12	200,000
TOTAL	1,200,000



Area = ½ x Height x Width

Example 4

Risk builds up as originally planned but delayed in handing over:

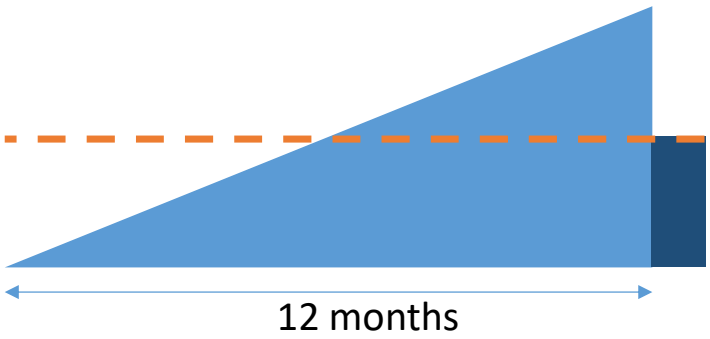


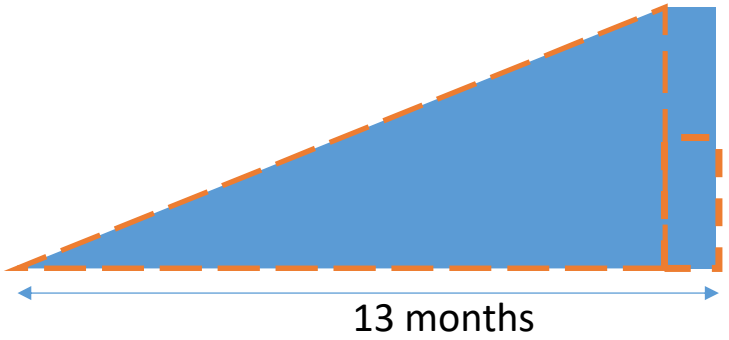
Premium ≈ Area

Premium = USD 1,200,000 + USD 200,000
= USD 1,400,000

Example 4

Risk builds up as originally planned but delayed in handing over:





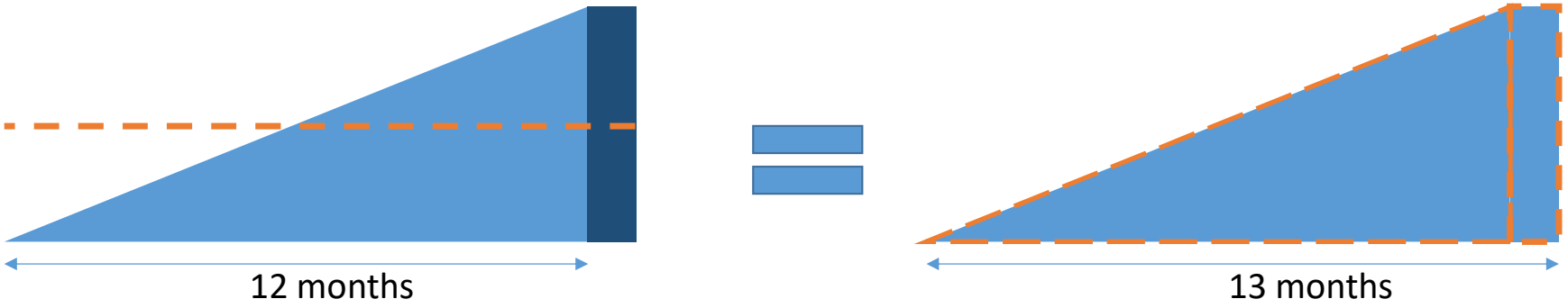
Pro Rata Premium = USD 1.2m + USD 100,000
= USD 1,300,000

Premium ≈ Area

Premium = USD 1,200,000 + USD 200,000
= USD 1,400,000

Example 4

Risk builds up as originally planned but delayed in handing over:



Pro Rata Premium = USD 1.2m + (200% x USD 100,000)
= USD 1,400,000

200% pro rata works

Key Points

- Period Extensions at pro rata may not be equitable to the pool if the project risk during the extension period is higher than the average over the whole period

AND

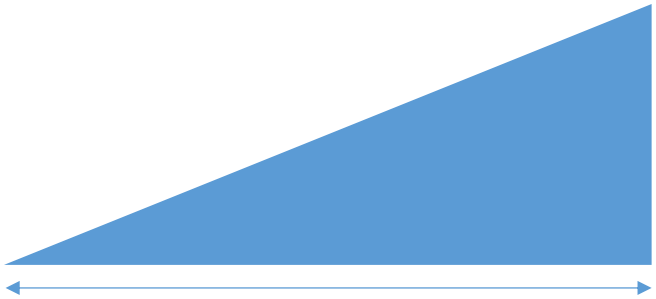
- Risk may be elevated as the insured parties try to make up for the delay

Period Extensions – Key Points

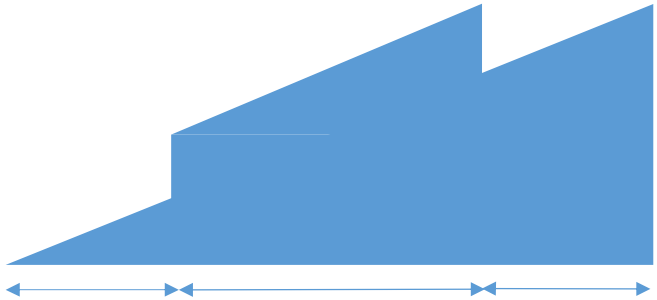
- Example 1: Risk builds up more slowly than originally planned
  - Pro rata may be equitable
- Example 2: Risk incepts but works not started straight away
  - Equitable to cover costs
- Example 3: Risk delayed early on in the project
  - Less than pro rata may be equitable
- Example 4: Risk builds up as originally planned but delayed in handing over
  - More than pro rata may be equitable
- Risk may be elevated as the insured parties try to make up for any delay

Construction Risks

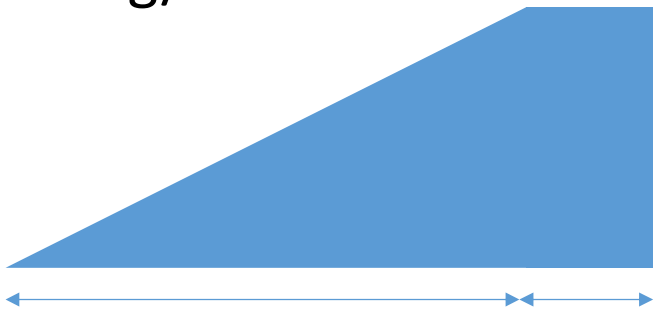
Simple:



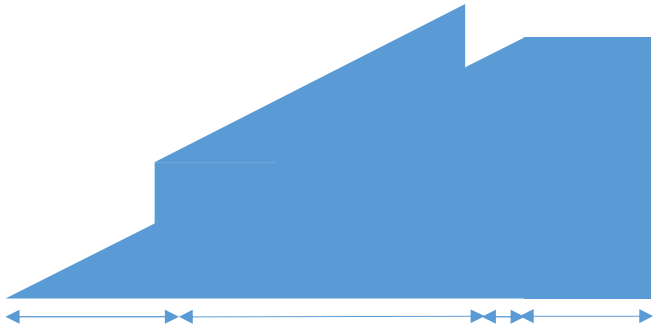
Nat Cat:



Testing/Fit-out:

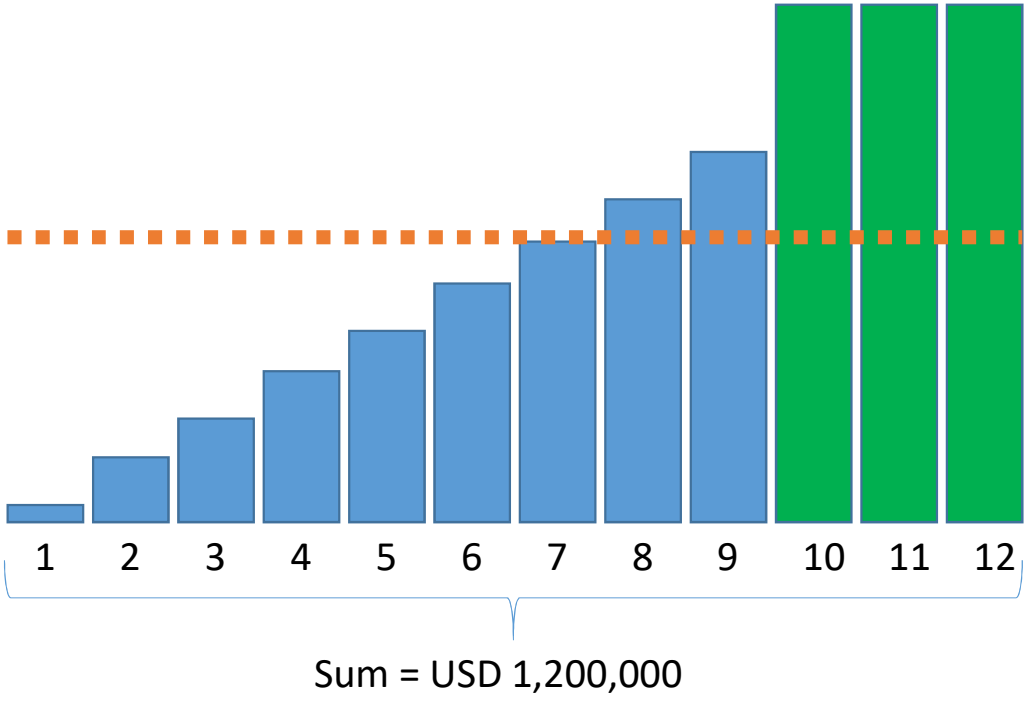


Composite:



Testing/Fit-Out

Premium allocation is often back-loaded:



Month	Premium
1	10,000
2	35,000
3	50,000
4	65,000
5	80,000
6	95,000
7	110,000
8	125,000
9	140,000
10	160,000
11	160,000
12	160,000
TOTAL	1,200,000

Testing & Commissioning premium is often worth:

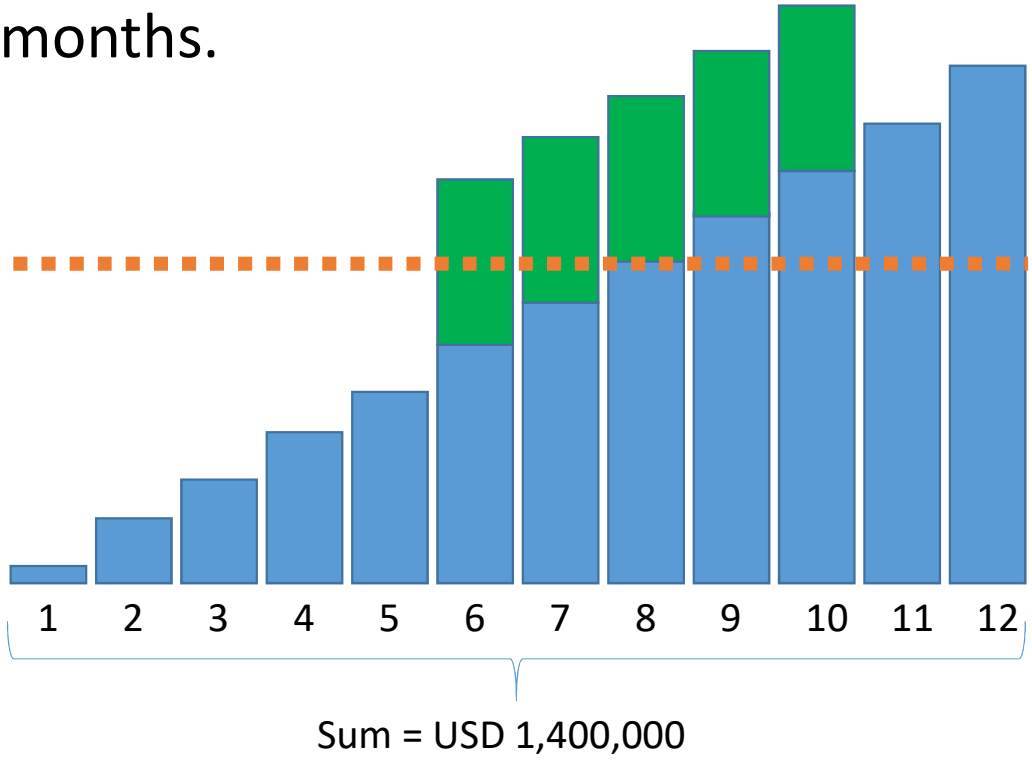
- 30% - 40% of the total original premium;
- 150% - 300% of the pro-rata monthly rate

3 x USD 160,000 = USD 480,000
40% of original premium

USD 160,000 / USD 100,000 = 160% of pro rata

Nat Cat

Seasonal natural catastrophe premium is allocated to the affected months.



Month	Non-Cat	Cat	Premium
1	10,000		10,000
2	25,000		25,000
3	40,000		40,000
4	55,000		55,000
5	70,000		70,000
6	85,000	40,000	125,000
7	100,000	40,000	140,000
8	120,000	40,000	160,000
9	140,000	40,000	180,000
10	160,000	40,000	200,000
11	180,000		180,000
12	200,000		200,000
TOTAL	1,200,000	200,000	1,400,000

Key Points

- Simple triangles are easy to visualise
- Even using simple shapes, calculating equitable extension premiums is not necessarily intuitive
- Premium allocation for construction projects is far more complex than pro-rata
- Choosing an percentage of pro-rata by visualising the risk is probably the best we can do

Policy Terms & Conditions

- Pro-rata means the average premium
- There is usually higher than average risk towards the end of a project
- Nevertheless, it is commonplace in the construction market to commit to extension provisions at pro-rata or even nil at the outset of a policy
- Underwriters do not know at the outset which scenario will apply at the point a period extension is needed (usually towards the end of a project)

Delay in Start Up

- Exposure usually increases with time:
  - Float may have been used up by insured and/or uninsured delays
  - Float in the project period reduces as activities centre on the critical path
  - The remaining time to the DSU trigger date becomes increasingly shorter than replacement times for key equipment
  - Activities are often more risky such as Testing & Commissioning
- DSU extensions should not automatically follow the terms for CAR/EAR extensions.
- New circumstances which were not contemplated at the outset of the contract should inform extension terms and conditions.

Summary

- Insureds must pay equitable premiums for pools to function
- Premium rates are just averages over time (pro-rata = average)
- Risk usually increases over time for construction projects
- It may not be equitable to charge the average premium when the risk is higher towards the end of a project
- Underwriters often set extension provisions at inception when the equitable extension premium is not known

Thank You