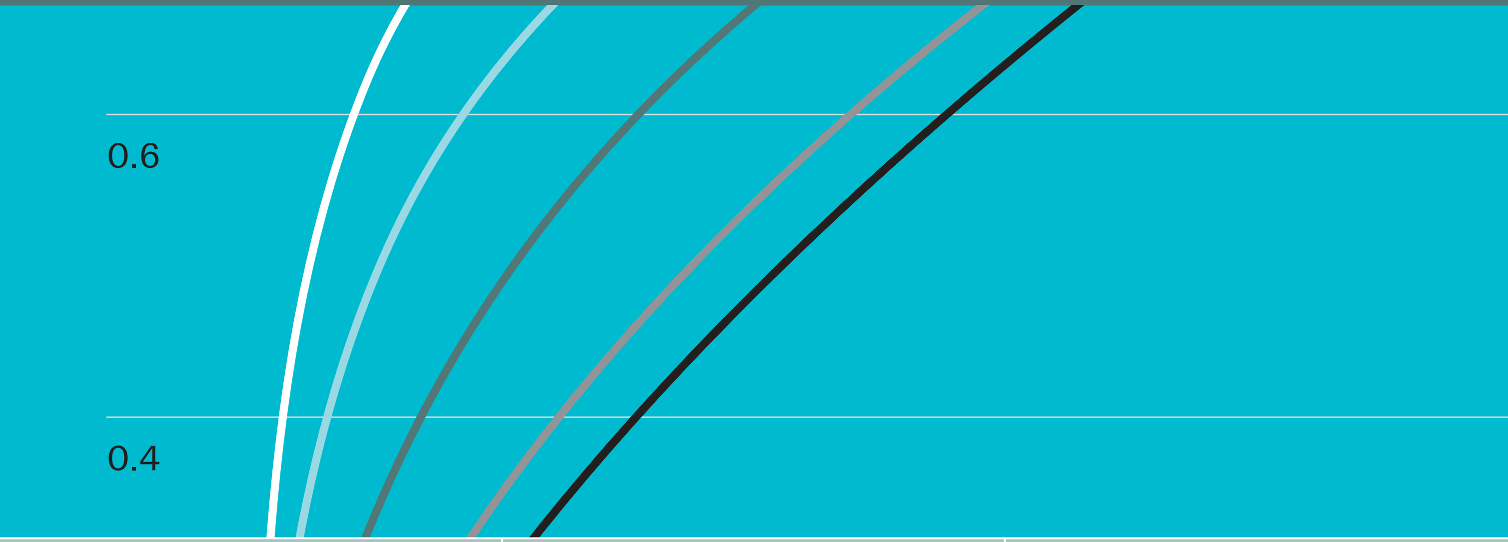
Swiss Re

Exposure rating



Technical publishing
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Foreword

It is over 25 years since Swiss Re last brought out a publication on exposure rating. Richard R. Doerr's publication, *Schadenprioritäten, Schadenlastverminderung und Prämienrabatt in der Feuerversicherung* ("Priorities, claims burden reduction and premium discounts in fire insurance"), published in 1977, described the effect of non-proportional elements in property reinsurance from the mathematician's perspective. A few years earlier, Peter Gasser had produced *Ein Beitrag zur Tarifierung von Einzelrisiken auf Zweit-Risiko-Basis* (A contribution to the rating of individual risks on an excess of loss basis). Although Peter Gasser's 1970 "contribution" was never published in brochure form, the Y1–Y4 exposure curves he described became known far beyond Swiss Re.

The publication in hand builds on the work of Doerr and Gasser. However, its author, Daniel Guggisberg, neither reworks mathematical principles nor seeks to introduce new exposure curves. Instead, his primary intention is to familiarise readers with the mechanisms of exposure rating and with the possibilities and limits of this method.

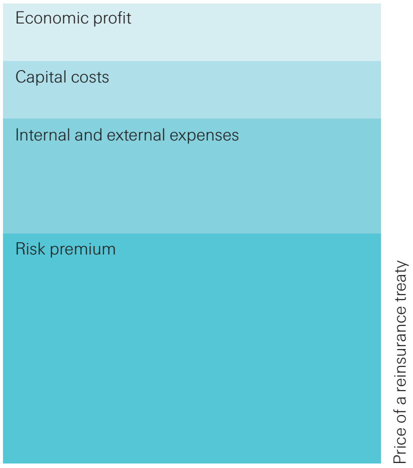
Daniel Guggisberg's explanations are geared to the conditions of property treaty reinsurance. However, exposure rating can be applied to entire portfolios and individual risks alike. The method remains the same. For this reason, this publication is aimed not only at treaty underwriters but also at underwriters of facultative reinsurance.

Peter Bütikofer
Group Product Management Property

Introduction

The price paid for a reinsurance contract is made up of various components, the most important of which is the risk premium. The risk premium should be sufficient, in the long term, to enable the insurer or reinsurer to pay from it all claims falling to it by reason of its contractual obligations. The risk premium is the premium required to cover the long-term average claims cost in a treaty period (ie the expected value of the loss distribution). The risk premium is estimated using specific methods (rating models).

Figure 1



Every reinsurance company also imposes loadings for internal and external expenses, for capital costs (costs of the capital required to back up the business – to absorb deviations from the expected claims experience, for example) and finally, for its profits (economic profit).

While loadings are dependent on the particular reinsurance company and are therefore set at different levels, the risk premium depends only on the business covered. In theory at any rate, it should therefore be assessed at the same value by all underwriters. One method of calculating it is exposure rating.

Exposure curves, which will be discussed in the following pages, are eminently suitable for taking account of non-proportional elements (for example, first loss retentions and loss limits) in insurance and reinsurance. However, the characteristics of exposure rating mean from the outset that it can only be considered for classes of (re)insurance with fixed/non-variable values and sums insured. Of all the classes of business which meet this prerequisite, property reinsurance is the focus of this publication.

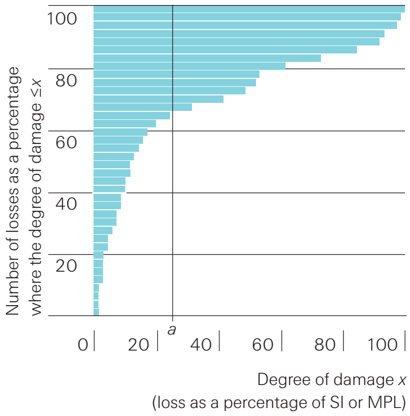
Exposure rating supplements or serves as an alternative to experience rating[1] in cases where we want a "second opinion" as further support for our calculations. It proves to be an essential aid above all where there is no representative or only insufficient claims experience available for us to calculate a burning cost. In such cases we can use exposure rating to look back at the claims experience of another portfolio of the same kind. This means that the claims experience we are missing can be derived from a reference portfolio whose claims experience is sufficiently well supported statistically. The pages which follow will show how this is possible and outline the procedure involved.

1 This term combines the burning cost and the Pareto model. Both of these methods of pricing in reinsurance are based on the losses that have occurred in the past in a particular portfolio. Experience rating works well as long as the quality of the portfolio has not changed over the years, or has changed very little. In other words, the claims statistics must be representative of the portfolio for which we want to determine the price of reinsurance cover.

Origin of exposure curves

In order to be able to use the claims experience of a different portfolio, the portfolio in question has to be put into suitable form and represented as a loss distribution. We therefore proceed as follows:

Figure 2



Step 1:
For a fire portfolio, let us assume that all the individual fire losses occurring over a particular period are known. In order to make losses affecting different-sized risks comparable with each other, the losses are assessed against some measure of the size of the risk (the sum insured[2] or the MPL[3], for example). If the losses are stacked on top of each other according to size as in Figure 2 and an appropriate scale is chosen for the two axes, the step function then represents the empirical loss distribution function. The area above the step function corresponds to the average claims burden which is to be expected for this portfolio.

However, this form of loss distribution on its own is not sufficient for pricing contracts with non-proportional elements. The effect of loss limits first has to be described in a second step.

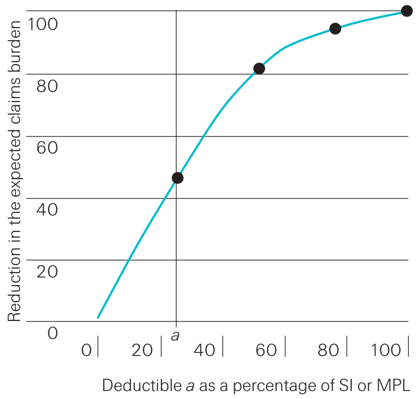
2 The sum insured is the insurer's limit of liability agreed in the insurance contract and fixed as a sum of money (definition after Willi Gruss, *Versicherungswirtschaft*, Bern 1977, p 104).

3 MPL: the maximum possible loss that can occur if all conceivable negative – and thus even improbable – circumstances accumulate in a particularly unfortunate way (definition after Klaus Gerathewohl, *Reinsurance. Principles and Practice*, Vol. II, Karlsruhe 1982, p 97).

Step 2:
In Figure 2, the dark area (claims burden) is divided into two parts by a vertical line at point a. The area to the left of the vertical line corresponds to the claims burden accounted for by losses and parts of losses which are smaller than a. If this partial area is divided by the area representing the entire risk premium, the value of a flat deductible amounting to a is obtained. If this calculation is carried out at every point and the results are transferred into a new figure, the result is an exposure curve (Figure 3).

If we divide up the total area in Figure 2 at the point a = 25%, then we can establish, using mathematical methods, that the area above the curve is divided roughly in the ratio 50:50.

Figure 3



In Figure 3, at the 25% of the SI (or MPL) point, we therefore read off a value of around 50% for the reduction in the claims burden. This means that 50% of the claims burden remains within the deductible, while 50% exceeds the deductible of 25% of the SI or MPL.

Characteristics of exposure curves

The shape of the exposure curve is determined by the underlying loss distribution. In order to visualise this, we shall first look at three hypothetical portfolios.

Figure 4
First portfolio: total losses only

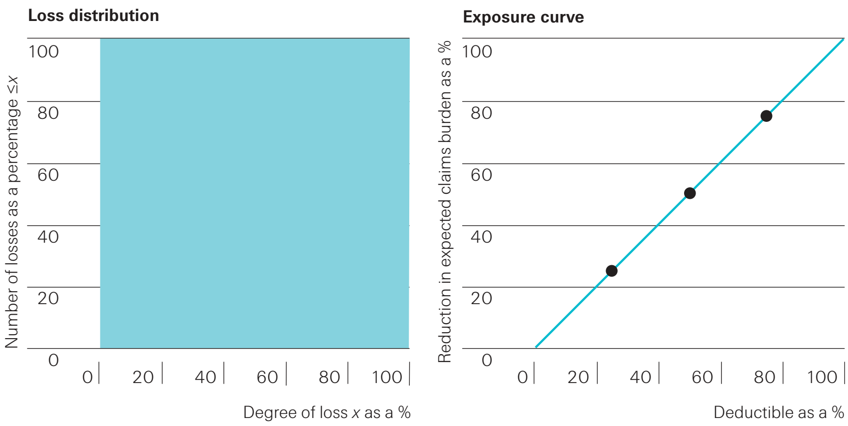
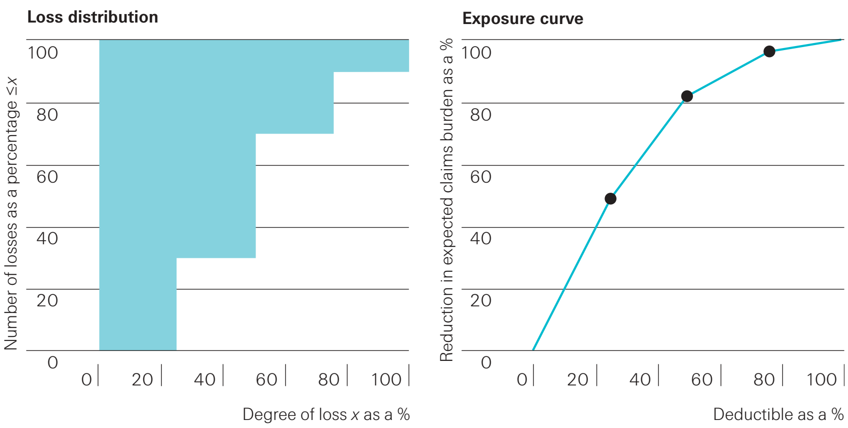


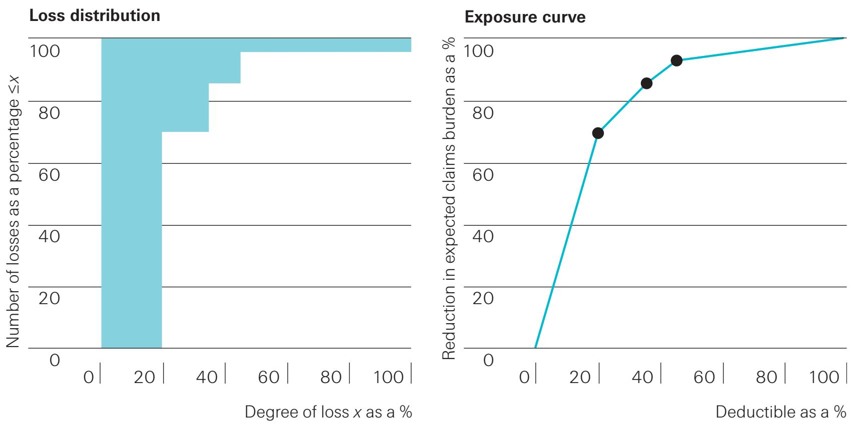
Figure 4 shows a portfolio having only total losses. For the property classes of business, however, total losses are not typical. For example, statistics show that in 90–95% of losses involving fire damage to buildings, the loss suffered amounts to less than 10% of the sum insured.[4] Small or partial losses are therefore the rule. We can take this into account by constructing two portfolios having a correspondingly larger proportion of partial losses.

Figure 5
Second portfolio: 10% total losses, 20% losses of 75%, 40% losses of 50%, 30% losses of 25%.



4 Richard R. Doerr, *Schadenprioritäten, Schadenlastverminderung und Prämienrabatt in der Feuerversicherung* (Priorities, claims burden reduction and premium discounts in fire insurance), Zurich: Swiss Re, 1977, p. 10.

Figure 6
Third portfolio: 5% total losses, 10% losses of 45%, 15% losses of 35%, 70% losses of 20%.



From the stepped loss distributions, we derive the relevant exposure curves in each case, using five individual observation points.

If the loss distributions and exposure curves for the three portfolios are compared it can be seen that:

- Exposure curves which tend towards the diagonal are based on loss distributions with a high proportion of total losses; in extreme cases, the exposure curve coincides with the diagonal.
- The further away from the diagonal an exposure curves ends up, the fewer total losses the relevant loss distribution has.
- Exposure curves are concave. In the exposure curves diagram they link the points (0/0) and (100/100), always rising and flattening out towards the top.

Whether a lot of total losses occur, or partial and small losses are the rule, depends on various factors, some of which are in turn dependent on each other. The decisive factors are the peril covered, the class of risk, the size of risk and the fire protection measures.

Perils covered
A fire normally causes more damage to an individual building than a windstorm: typical windstorm losses in Europe amount to only a few per mil of the sum insured. While a gas explosion can completely destroy a house, lightning strikes generally cause only partial damage. Earthquakes, on the other hand, cause minor to devastating damage to buildings, depending on their strength.

Class of risk[5]
The class of risk has a decisive influence. Gunpowder factories are obviously more likely to suffer total losses than food processing plants. Depending on the class of risk, the average degree of loss varies considerably, as the following statistical details illustrate:[6]

Class of risk	**Average degree of loss**
Residential building	1.9%
Administration building	0.5%
Farm building	4.9%
Industrial building	4.4%

Size of risk
A fire often causes only partial damage to a large building, whereas small buildings are more likely to suffer total destruction in the event of a fire. The obvious measure for the size of a risk is the sum insured. However, this is only a good indicator for the risk as long as the insured property can be destroyed by a single fire event. This is the case with detached houses, for example.

Large industrial plants, in contrast, often consist of several groups of buildings which are clearly separated from each other and therefore cannot be affected simultaneously by a fire. The sum insured may give an indication of the size of the entire industrial plant but does not allow any conclusion to be drawn on the effective size of the risk. The MPL[7] is therefore often used as a measure of the size of the risk. The larger a risk, the smaller the MPL usually is as a percentage of the sum insured.

Fire protection measures
Fire protection has a considerable influence on the course of the loss distribution function. Fire protection measures make it possible to stop hostile fires at an earlier stage, thereby reducing the total overall claims burden which is to be expected over a certain period and increasing the share of the overall claims burden accounted for by minor losses.

5 Our comments on the other influencing factors (class of risk, size of risk, fire protection) are taken from the Swiss Re publication *Schadenprioritäten, Schadenlastverminderung und Prämienrabatt in der Feuerversicherung* (Priorities, claims burden reduction and premium discounts in fire insurance), Swiss Re 1977 (Richard R. Doerr), pp 11–14.
6 According to data from the Swiss Intercantonal Reinsurance Association (IRV) for the years 1991 to 1996.
7 MPL = maximum possible loss (see Footnote 3).

Summary

If we compile the most important points from our considerations in tabular form, we can intuitively compare the exposure curves of risks exposed to specific perils and arrange them in relation to each other:

Peril/Type	**Curve tends towards the diagonal**	**Curve runs in the middle area**	**Curve runs in the outer area**
Fire	EML[8] (as a measure of the size of the risk in the exposure curve diagram)	MPL[9]	SI[10]
	Risks with poor fire protection	Risks with average fire protection	Risks with good, above-average fire protection
	Personal lines	Commercial lines	Industrial lines
	Farm building	Industrial building	Administrative building
Windstorm		Radio tower	Office building
Hurricane	Radio tower	Office building	

The table shows that exposure curves are determined by the interaction of various factors. They are clearly determined by their underlying portfolios and are therefore not arbitrarily transferable.

8 EML = estimated maximum loss, or the largest loss that could occur under normal conditions of operation, use and loss prevention (eg intervention of fire brigade, operation of fixed extinguishing systems) in the building in question, whereby any exceptional circumstances (accident or unforeseen event) which could significantly alter the risk are ignored (definition as per the *Comité Européen des Assureurs*).

9 See Footnote 3.

10 See Footnote 2.

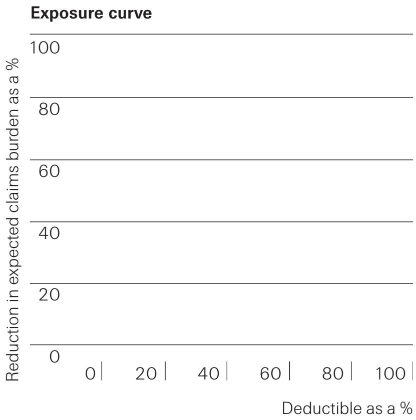
Exercises

You have already learnt something about which factors influence the shape of an exposure curve. From the three examples below, consider which risks will be a total loss and which ones are more likely to be partial losses. How do the relevant exposure curves differ from each other as a consequence?

1
Class of business: fire

Draw a typical exposure curve for the insurance of a

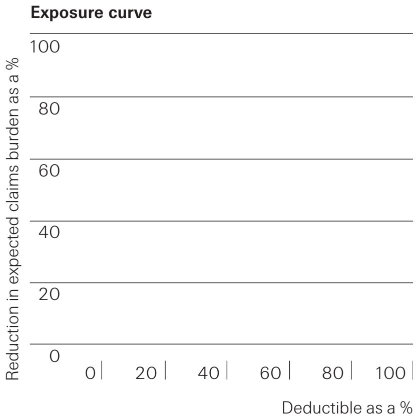
- petrochemical plant
- brewery



2
Class of business: theft

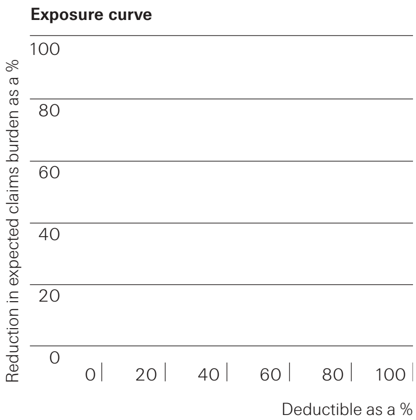
Draw a typical exposure curve for theft insurance in respect of

- household contents
- individual art objects



3
Class of business: property

Draw two exposure curves that are not possible.



You will find the answers to the exercises on pages 27–29.

Exposure curves for fire hazards per risk

Exposure curves for small to medium-sized risks

Over the years, Swiss Re has developed many exposure curves for various areas of application. The best known are probably the “Gasser curves” Y1–Y4, named after Peter Gasser, who devised them. The curves are derived from the “Brandstatistik der Vereinigung kantonaler Feuerversicherungsanstalten” (fire statistics of the [Swiss] Association of Cantonal Fire Insurance Institutions) for the years 1959–1967. In this connection, the question arises as to how far statistics from the 1960s are still relevant to the present. The strongest argument in favour of the continued use of the Gasser curves is the fact that they have always proved to be reliable in practice and – regardless of their origin – have even proved to be usable worldwide as a rating tool.

Peter Gasser arranged and analysed the statistical material available to him on the basis of the following risk groups:[11]

Risk group	Building sums insured from		to	
1 Personal lines	CHF	200 000	CHF	400 000
2 Commercial lines (small-scale)	CHF	400 000	CHF	1 000 000
3 Commercial lines (medium-scale)	CHF	1 000 000	CHF	2 000 000
4 Industrial lines and large commercial	over CHF	2 000 000		

Note: Compared to the Gasser data, the values given in the table have been adjusted to current conditions and have been rounded generously. The categorisation by type of business (personal lines, commercial lines, industrial lines) is also not original, but was added later. Together with the details of the building sums insured, it describes the area of application of the exposure curves Y1–Y4.

For each of the four risk groups, Gasser used empirical data to arrive at an exposure curve which can be applied to risks of the corresponding size (on the basis of the SI). As the curve for the group of the smallest risks, Y1 runs nearest to the diagonal, whereas Y4 runs furthest away from it.[12]

Exposure curves for industrial risks

For small to medium-sized industry, Gasser curve Y4 can be used, although, just like curves Y1–Y3, this one relates to sums insured. Industrial risks are usually ceded on an MPL basis, however. In the case of small to medium-sized industry, we can assume that the MPLs and the sums insured for these differ little from each other or are even identical.

11 Described in detail in Peter Gasser’s *Ein Beitrag zur Tarifierung von Einzelrisiken auf Zweit-Risiko-Basis* (A contribution to the rating of individual risks on an excess of loss basis), Zurich: Swiss Re, 1970.
12 For a graphical representation of the four curves, see Appendix A.

This assumption does not apply where large-scale industry is concerned. Such firms generally have production facilities in several locations, some of which may be far apart geographically. If we see the production facilities as risk units, we quickly realise that, measured against the firm as a whole, only partial losses are possible. The exposure curve based on the sum insured accordingly lies very close to the Y axis for this class of risk. For the same class of risk, the exposure curve based on the MPL again shows a more usual picture, but depending on the geographical distribution of the risk units and their relative size, it follows an even steeper course than each of the Gasser curves. These should therefore not be used for rating large industrial risks.

Underwriters at various reinsurance companies work with exposure curves originating in the London reinsurance market. Thus at Swiss Re, to name but one, the curve used for industrial business is one ascribed to Lloyd's of London, though in fact its origins can no longer be traced precisely. Like the Gasser curves, it is based on sums insured, but contains an even bigger proportion of partial losses than Y4. For this reason, within Swiss Re, the Lloyd's curve is also known as "Y5". It is suitable for rating industrial risks ceded to reinsurance on the basis of their "top location".[13]

Some of the big industrial companies insure their risks with the help of so-called captives. These company-owned insurers bear a large part of the claims burden themselves and often only go to the reinsurance market to protect themselves against major loss events. Many small losses are therefore no longer passed on to the market and so do not appear in the statistics, with the result that major and total losses have a greater impact. Exposure curves for captive business therefore tend more towards the diagonal than curves which are based on the entire claims burden.

For this reason, Swiss Re has developed three captive curves: for fire, for business interruption, and for fire and business interruption combined. The three exposure curves can also be used outside their original area of application on qualitatively comparable portfolios typically made up of layered and high-deductible policies.

As the captive curves came into being after the Gasser curves and the Lloyd's curve, they are classified as "Y6" at Swiss Re. While the designation "Y6" reveals something about the history, it says nothing about the shape of the captive curves; in a graphical representation, they actually lie between Gasser curves Y3 and Y4.

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13 The "top location" is the individual location within an "account" (ie an insured company) which has the highest insured values. Alternatively, the "top location" can also be related to the MPL (maximum possible loss) or to other, similarly defensive loss scenarios.

For oil and petrochemicals (OPC), there are three exposure curves which were developed at Swiss Re some years ago from claims data on OPC business. Here too, there is a curve for fire, for business interruption, and for fire and business interruption combined. The OPC curve for fire runs in the area of Gasser curve Y2 and the one for business interruption between the diagonal and Y1, whereas the curve for fire and business interruption combined lies between Y1 and Y2. All three curves therefore point to a high proportion of major losses, which are typical for OPC. Because the original deductibles in this segment of industry are usually high, major losses are of greater importance as regards the claims burden ceded to reinsurance. What effect this has on the exposure curve has already been explained using the example of captives.

Note: With the rating software used by Swiss Re, one of the options is to rate on an exposure basis. To this end, the software provides a continuous family of curves which can be described by a single parameter c. In this way, it is possible to map not only each of the exposure curves presented but also every usual exposure curve, at least approximately.[14]

Summary in tabular form[15]

Exposure curve		Scope of application	Basis	Size of risk
Gasser	Swiss Re software parameter c			
	not defined	OPC business interruption	MPL	
Y1	1.5	Personal lines	SI	≤ CHF 400 000
	not defined	OPC property damage/ business interruption	MPL	
	not defined	OPC property damage	MPL	
Y2	2	Commercial lines (small-scale)	SI	≤ CHF 1 000 000
Y3	3	Commercial lines (medium-scale)	SI	≤ CHF 2 000 000
	3.1	Y6: Captive business interruption	MPL	
	3.4	Y6: Captive property damage/ business interruption	MPL	
	3.8	Y6: Captive property damage	MPL	
Y4	4	Industrial and large commercial	MPL	> CHF 2 000 000
	5	Lloyd´s (Y5): Industry	Top location	
	up to 8	Large-scale industry/ multinational companies	MPL	

14 The method is described by Stephan Bernegger in "The Swiss Re Exposure Curves and the MBBEFD Distribution Class", Astin Bulletin Vol. 27, No. 1, 1997, pp 99–111.
15 A graphical representation of the curves can be found in Appendix A, p. 26.

Use of fire exposure curves in treaty reinsurance

Basic considerations
A portfolio generally consists of risks that differ in size and quality. These are exposed to various perils which are insured in different ways, depending on the conditions of insurance. If the portfolio being rated is also divided into classes containing risks of the same kind, we can select and use the appropriate exposure curve for each class and peril for which we wish to determine a reinsurance price. In an extreme case, there may be no suitable curve available. The best fit from among all the curves should then be used as an indication, and the result compared with another rating method.

Risk profile
Making good use of the exposure curves requires specific knowledge of the underlying portfolio. This offers us a so-called "risk profile" which presents the portfolio in a structured and clearly laid out form. A risk profile should be built up along the following lines:
- Status of the portfolio shown, as of ...
- Units shown: per risk, or possibly per policy or account
- Basis of cession specified: sum insured, MPL, EML or ...
- Breakdown of the portfolio into sums insured or EML/MPL bands for the perils that are to be covered by a particular treaty
- Specification per band of the relevant
  - number of risks (or possibly policies, accounts)
  - sums insured or MPL, EML
  - premiums

The premiums and one of the two other values at least must be known for each band. In the following example we will use the premiums that the insurers receive for their portfolio. This needs explaining, for – as we have seen – exposure curves are drawn up on the basis of a specific claims experience and are therefore based on losses and not on premiums. Nevertheless, they can still be used to distribute original premiums, as risk premiums correspond to the mean expected claims burden and are essentially nothing but the payment for losses. If the claims experience shows an average claims burden for fire of 70% of the original premium, for example, this indicates that these 70% correspond to the fire risk premium. This means that, besides the risk profile, we also need information on the cedant's average claims burden from fire losses over several years. Market statistics may also be used as an alternative to this, or to complement it.

The risk profile should, if possible, be drawn up on a net basis as used in proportional prior reinsurance (important in the case of the surplus treaty). Ideally, there should be a risk profile for each type of risk, so that we could recognise not only the size of the risks but also their quality. This would make it easier to choose the appropriate exposure curve.

Note: Choosing the right exposure curve for rating is only possible with fully detailed information about the portfolio. In practice, however, the information is often incomplete. The missing figures can sometimes be obtained from other sources, or replaced with experience figures. However, one must make sure that the risk profile used is up-to-date and representative in each case.

Often the only risk profile available does not correspond to the desired basis. Risks may be broken down according to their sum insured, for example, whereas the cession to reinsurance is made on an MPL basis. In some cases, a profile may contain sums insured, EMLs and MPLs alongside each other, without any distinction. Of course, in these cases too, justified assumptions about a portfolio's structure can also help. However, the results achieved in this way are often unsatisfactory. Where insufficient information is available, exposure rating should not be used, or otherwise used only as a supplement to other methods of calculation.

Rating example

Conditions
In the following example, we show the individual steps involved in exposure rating. For the sake of simplicity, we have confined ourselves to the peril of "fire".

The aim is to find the risk premium for a per risk WXL cover with the limits

CHF 3 500 000 xs CHF 1 500 000.

The risk premium applies for 2004, covers a proportional deductible of
CHF 5 000 000 on an MPL basis and pays only in the case of fire losses.
The GNPI amounts to CHF 95 975 000.

The gross risk profile provided by the cedant is from 2002 and therefore does not correspond to the portfolio's current status. In order to be able to use the risk profile nevertheless, we index the 2004 treaty limits back to the 2002 values. This is easier than correcting all the figures to the conditions applying in 2004. However, if influencing factors other than inflation are to be taken into account between 2002 and 2004, back-indexing is not enough. In this case, larger corrections to the risk profile are required, the question then being whether the profile is still representative at all.

Step-by-step procedure

1 Determine the average sum insured or the average MPL per band.
2 Calculate the net premium per band.
3 Express the priority and the limit of cover of the programme being rated as a percentage of the mean sum insured (or of the mean MPL) per band. The upper limit here is 100%.
4 Choose the appropriate exposure curve according to the size of the mean gross MPL.
5 For each band, read off the XL premium as a percentage of the net premium.
6 Use this to calculate the premiums per band.
7 Find the sum of the XL premiums over all the bands.
8 Multiply the sum by the fire loss ratio.
9 Determine the risk premium rate (divide the risk premium by the relevant GNPI).

Columns 1–3 in Table 1 are provided by the cedant. We have added Columns 4 and 5 ourselves. From 2002 to 2004, the construction cost index rose from 457 to (an estimated) 550 points. Allowing for inflation, the maximum deductible desired in 2004 of CHF 5m MPL 2002 would have been equivalent to a deductible of CHF 4.155m MPL (back-indexed with the factor 457/550). The deductible in Column 4 does not exceed this value.

Column 5 is the consequence of Column 4. The cedant retains for itself all premiums up to the MPL of CHF 4.155m. The premiums for higher classes of MPL are divided proportionally. For example: 4.155m/4.750m = 87.7%. (87.47% of the gross premium of CHF 1.490m is CHF 1.303m).

If we redefine all the premiums in Column 3 anew, as described, we obtain a net premium volume of CHF 76 301m, which corresponds to the 2002 cost situation.

Table 1: Apart from in Columns 6 and 8, all the figures are given in thousands:

1 Max. MPL	2 Mean MPL gross	3 Gross premium	4 Mean MPL net	5 Net premium as per 02	6 Ded. as % of mean MPL	7 Exp. curve	8 XL premium as a %	9 XL premium
150	75	33 434	75	33 434	100%	Y1	0%	0
250	200	14 568	200	14 568	100%	Y1	0%	0
400	325	6 324	325	6 324	100%	Y1	0%	0
600	500	4 584	500	4 584	100%	Y2	0%	0
800	700	3 341	700	3 341	100%	Y2	0%	0
1 000	900	1 405	900	1 405	100%	Y2	0%	0
1 250	1 125	1 169	1 125	1 169	100%	Y3	0%	0
1 500	1 375	683	1 375	683	91%	Y3	3%	20
1 750	1 625	613	1 625	613	77%	Y3	8%	49
2 000	1 875	554	1 875	554	66%	Y3	13%	72
2 500	2 250	700	2 250	700	55%	Y4	10%	70
3 000	2 750	552	2 750	552	45%	Y4	15%	83
4 000	3 500	1 194	3 500	1 194	36%	Y4	21%	251
5 500	4 750	1 490	4 155	1 303	30%	Y4	25%	326
9 000	7 250	4 177	4 155	2 394	30%	Y4	25%	598
12 500	10 750	3 527	4 155	1 363	30%	Y4	25%	341
18 000	15 250	3 249	4 155	885	30%	Y4	25%	221
24 000	21 000	2 712	4 155	537	30%	Y4	25%	134
36 000	30 000	2 588	4 155	358	30%	Y4	25%	90
48 000	42 000	1 988	4 155	197	30%	Y4	25%	49
72 000	60 000	657	4 155	45	30%	Y4	25%	11
90 000	81 000	1 918	4 155	98	30%	Y4	25%	25
		91 427		76 301				2 340
Max. deductible as per 02		4 155				Desired deductible		1 246

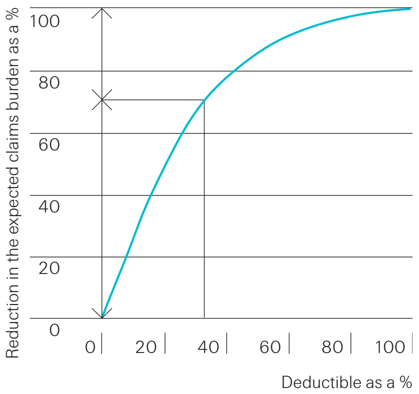
The desired programme for 2004 of CHF 3 500 000 xs CHF 1 500 000 corresponds in 2002 to a layering of CHF 2 908 182 xs CHF 1 246 364 (limits *457/550).

The price of the newly determined layer is calculated with the help of Columns 6–9 in Table 1. We base our calculations on Peter Gasser's exposure curves, which are to be found in Appendix A to this brochure, on page 26.

- Column 6 expresses the priority as a percentage of the mean MPL (Column 4), the maximum value here being 100%.
- In Column 7, for each risk band, we choose the exposure curve corresponding to the average MPL in Column 4 (= class/size of risk).
- The percentages in column 8 are taken from the corresponding exposure curve.

  The difference between (max.) 100% and the value read off from the curve corresponds to the proportion of the total claims burden accepted by the layer (Figure 7).

Figure 7



  Risk bands 1–7: The desired priority of CHF 1 246 364 is greater than the mean MPL of the band (= 100%). At point x = 100% in the figure on page 24, all the values of y amount to 100%. The calculation is therefore 100%–100% = 0%.
  Risk band 8: The desired deductible of CHF 1 246 364 corresponds to around 91% of the mean MPL of 1 375 000 in this band. At point x = 91%, the figure shows a value of 97% for Y3. The calculation is therefore 100%–97% = 3%.

- Column 9 corresponds to Column 8 multiplied by the premiums per band from Column 5.

The sum of all the premiums calculated for the CHF 2 908 182 xs CHF 1 246 364 layer comes to CHF 2.269 million.

However, from the cedant's claims statistics we see that, on average, the cedant only has to spend about 55% of its premium volume, which it would like to have protected by means of the WXL/R, on paying fire claims. The risk premiums for the layer consequently amount to 55% of CHF 2.269m = CHF 1.248m. This corresponds to a risk premium rate of 1.636% of the net premium volume for 2002 (CHF 76.301m).

As we have projected the 2004 treaty back to the conditions applying in 2002, the premium rate of 1.636% in our case also applies for the 2004 programme of CHF 3 500 000 xs CHF 1 500 000. The risk premiums for 2004 therefore amount to CHF 1 570 151 (= 1.636% x CHF 95 975 000), which corresponds to a rate on line of 44.861%.

Note: In our example, we worked with a loss ratio that was uniform for the entire portfolio. Ideally, however, we should know the average claims burden per band over several years, so that we can make differentiated statements about risk premiums. If we rely only on average values, we often estimate the claims burden, and with it the risk premiums, incorrectly. As we have seen from the example, when rating a surplus, we work only with the premiums for the risks which expose the reinsurance treaty. Average values for the portfolio as a whole comprise all risks, however, including those which remain within the cedant's deductible. If we work with the average claims burden per band, it makes only a small difference to the above calculation procedure: the values in Column 9 of the table must first be multiplied by the relevant loss ratio per band before the partial results determined in this way are added to the risk premium for the layer. Depending on the individual case, the result can differ considerably from that obtained using the simplified calculation.

Exposure rating in natural hazards reinsurance

In principle, experience and exposure rating are also possible for natural hazards covers. However, for portfolios with natural hazards exposure there is mostly no representative claims experience available, as the return periods for significant events can be decades or even centuries. In addition, it is difficult to index past loss events, as the distribution of the insured values and their quality can change considerably over time. Thus, as a rule, only an estimate of the possible event losses based on the values currently insured and the relevant frequencies of occurrence can give a realistic picture of the natural hazards risk.

The natural hazards risk of a portfolio is essentially always determined by the four elements: exposure, vulnerability of the insured values, distribution of the values over geographical zones and classes of risk and the original covers applying.

Exposure: How often are earthquakes, windstorms or floods of a certain intensity to be expected in a particular region? Depending on the level of information available, this can be modelled more or less reliably by evaluating historical events and producing an exposure model.

Vulnerability: What destruction to an insured property or portfolio is to be feared in the event of a certain earthquake intensity or wind speed or a particular degree of flooding? By analysing past catastrophe losses, attempts are made to quantify the relationships between natural hazard parameters (for example, Modified Mercalli Intensity for earthquakes, or wind velocity for storms), specific risk characteristics (for example, line of business, types of buildings) and the expected damage (usually expressed as the "mean damage ratio" or "MDR" = loss as a percentage of the total sums insured in a portfolio).

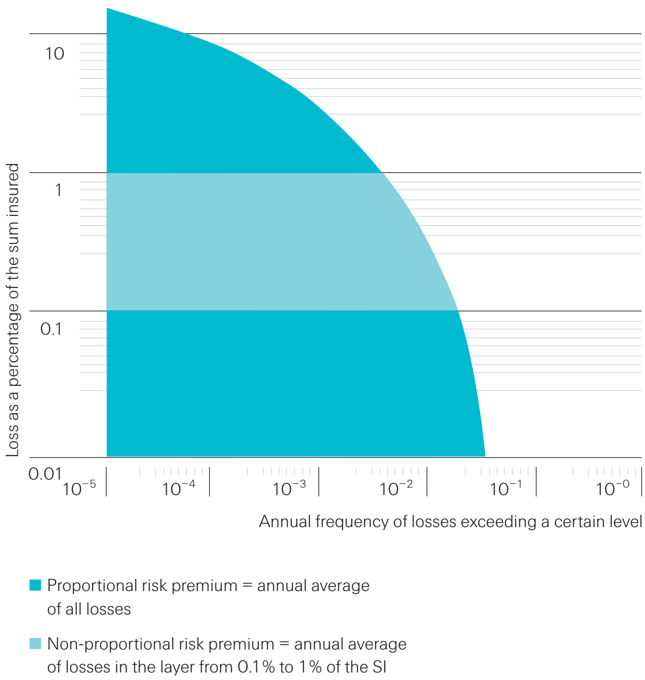
The classification of insured values by geographical zones and risk characteristics is central to the assessment of natural hazard risks, as this allows better estimates to be made of what values may be affected by the same event. Nowadays, reinsurers usually obtain the information needed for the assessment using CRESTA[16], a standard which is accepted worldwide. However, CRESTA data may not be detailed enough, particularly when the risk of flooding is being assessed. In this case it is necessary to work at a finer resolution – with postal areas, for example.

At the end of the day, the loss potential from an event is also heavily influenced by the original conditions, for example through deductibles. These cause small losses borne by the insured to fall outside the insurance cover. Other important influencing factors are sublimits, underinsurance, claims settlement practice, the moral hazard and inflated building costs in the wake of disasters.

16 CRESTA: Catastrophe Risk Evaluating and Standardising Target Accumulations.

For natural hazards, such considerations of exposure can be carried out systematically only with the help of computer programs. Various programs of this kind are in use at Swiss Re. The end result is a so-called event loss/frequency correlation. The loss which is to be expected in a portfolio can be read from a loss frequency curve (see Figure 8) for various frequencies of occurrence (for example, 0.01 corresponds to once in a hundred years, while 0.001 corresponds to once in a thousand years). Risk premiums for proportional and non-proportional covers can be derived from this information. The proportional risk premium is nothing but the annual average of all possible event losses from ground up, whereas the non-proportional risk premium is the annual average of the losses affecting a layer.

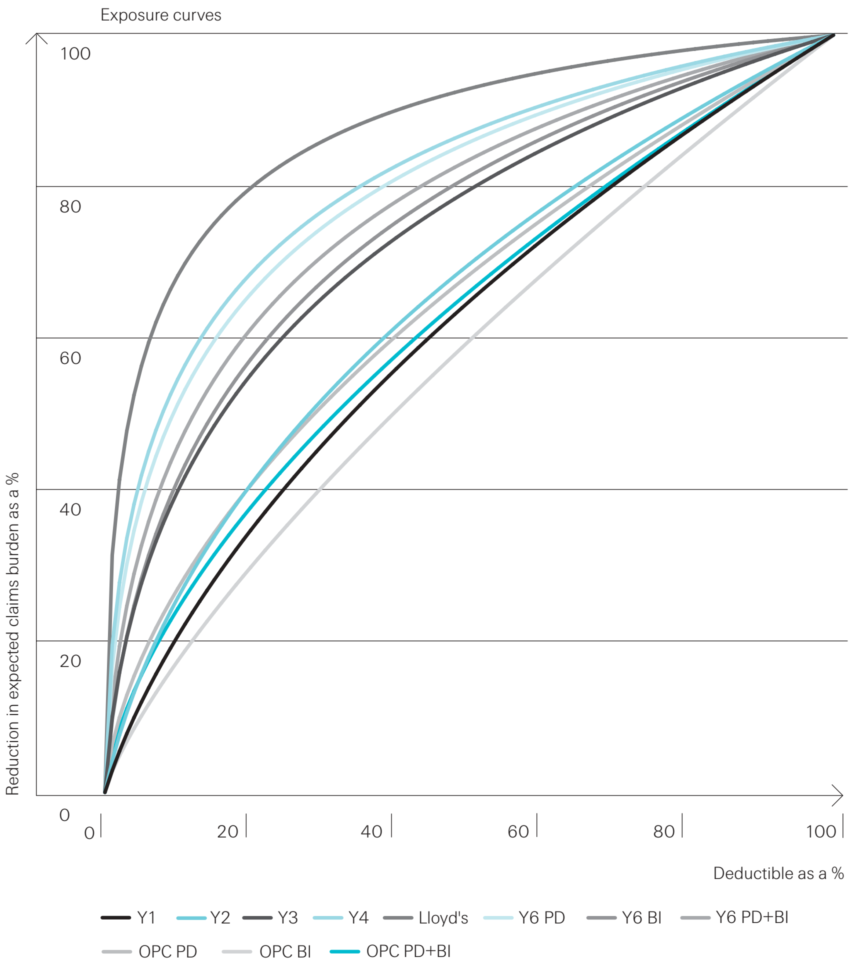
Figure 8



Appendices

Appendix A

Graphical representation of the exposure curves described in the text



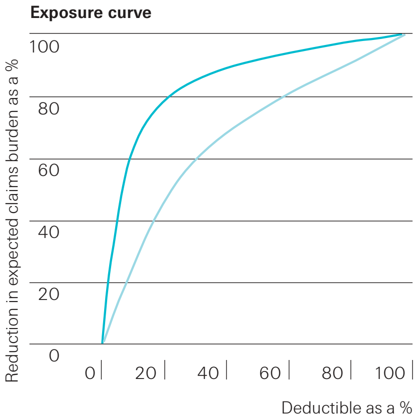
Appendix B

Answers to the exercises on page 14

1
Class of business: fire

Draw a typical exposure curve
for the insurance of a

- petrochemical plant
- brewery

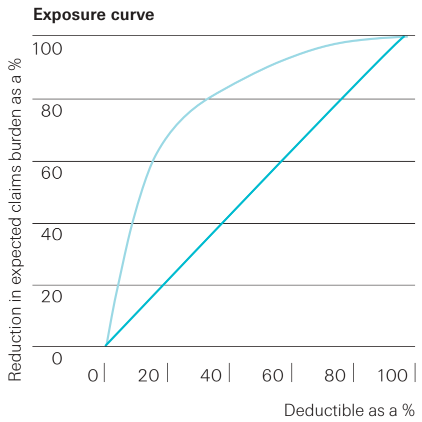


Explanation: In a petrochemical plant, it is mainly oil and natural gas that are processed. The risk of fire and explosion is thus higher, and major losses occur more frequently than is the case during the production of beer, for example.

2
Class of business: theft

Draw a typical exposure curve for theft insurance in respect of

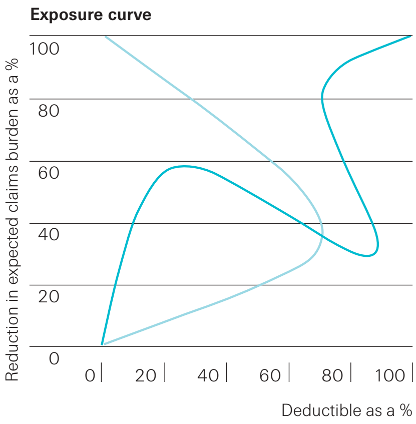
— household contents
— individual art objects



Explanation: Household contents are hardly likely to be stolen in their entirety. We therefore have to work on the basis of partial losses, whereas the theft of an individual insured art object amounts to a total loss.

3
Class of business: property

Draw two exposure curves that are not possible.



Explanation: Exposure curves are concave, ie in an exposure curve diagram they link points (0/0) and (100/100), always rising and flattening out towards the top.

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Swiss Re's P&C publications are edited and produced by Technical Communications, Chief Underwriting Office.

Title:
Exposure rating

Author:
Daniel Guggisberg, UP

This publication is an updated version
of the 2000 edition of the same title.

Editing and production:
Technical Communications
Chief Underwriting Office

Translation:
Group Language Services

Graphic design:
Logistics/Media Production

Cover: d signsolution, Zurich

Order number: 1501265_04_en
Property & Casualty, 07/04, 2000 en

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