Coverage Modifications 30M

All insurance coverages have some combination of coverage modifications, i.e., deductibles, policy limits, and coinsurances. In this subsection, we will discuss these coverage modifications, along with their objectives and types.

Deductibles

A deductible is the amount of each claim that the **policyholder** is responsible for paying before the insurer will pay a claim.

There are several types of deductibles, including the following:

- Fixed dollar deductibles
- Fixed percentage deductibles
- Disappearing deductibles
- Franchise deductibles
- Fixed dollar deductibles per calendar year
- Elimination periods

Fixed Dollar Deductibles

A ***fixed dollar deductible*** has a fixed dollar amount, regardless of the loss size.

For a policy that has a fixed dollar deductible of d, the insurer pays nothing for a loss (X) that is below d, and the amount in excess of d for a loss that exceeds d.

$$Y = \max(0, X-d) = \begin{cases} 0, & X \le d \\ X-d, & X > d \end{cases} \qquad \text{(S1.2.1.1)}$$

It is also known as an ***ordinary deductible*** or a ***deductible***.

Fixed Percentage Deductibles

A *fixed percentage deductible* can be a percentage of the loss or the policy limit. It is usually paired with a minimum dollar deductible so that the insurer does not need to handle small claims.

For a policy that has a fixed percentage deductible that is $100\delta\%$ of the loss, with a floor of d, the effective deductible for a loss size of X is

$$D = \max(d, \delta X) = \begin{cases} d, & X \le \dfrac{d}{\delta} \\ \delta X, & X > \dfrac{d}{\delta} \end{cases} \tag{S1.2.1.2}$$

and the insurer's payment is

$$Y = \begin{cases} 0, & X \le d \\ X - d, & d < X \le \dfrac{d}{\delta} \\ (1-\delta)X, & X > \dfrac{d}{\delta} \end{cases} \tag{S1.2.1.3}$$

Disappearing Deductibles

A *disappearing deductible* decreases linearly within a specific loss range.

For a policy that has an initial deductible of d that decreases linearly to zero between the loss sizes (X) of a and b, the effective deductible is

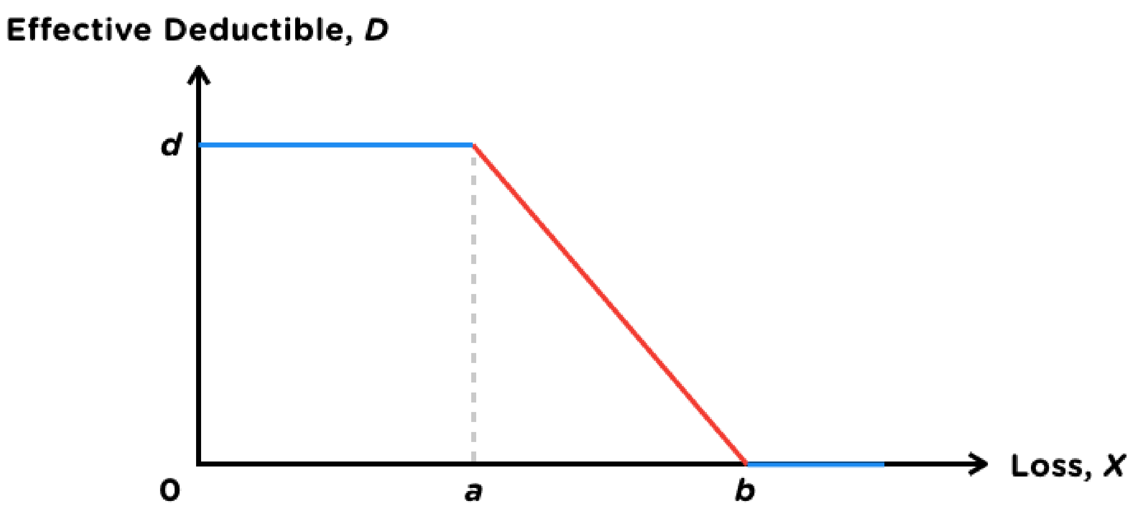
$$D = \begin{cases} d, & X \le a \\ d\left(\dfrac{b-X}{b-a}\right), & a < X \le b \\ 0, & X > b \end{cases} \tag{S1.2.1.4}$$

and the insurer's payment is

$$Y = \begin{cases} 0, & X < d, \\ X - d & d \le X \le a \\ X - d\left(\dfrac{b - X}{b - a}\right), & a < X \le b \\ X, & X > b \end{cases} \tag{S1.2.1.5}$$

Note that $d \le a < b$.

Below is an illustration of a disappearing deductible. The red line represents the linearly decreasing deductible over the interval where the deductible decreases from d to 0.



Franchise Deductibles

A ***franchise deductible*** is also known as a ***cliff disappearing deductible***. Unlike a disappearing deductible, which decreases linearly to 0 within a loss range, a franchise deductible decreases to 0 as soon as the loss exceeds the deductible.

For a policy that has a franchise deductible of d, the insurer pays nothing for a loss (X) that is below d, and the **full amount** for a loss that exceeds d.

$$Y = \begin{cases} 0, & X \le d \\ X, & X > d \end{cases} \qquad \text{(S1.2.1.6)}$$

Franchise deductibles used to be common in ocean marine insurance, but they are not very common anymore.

Fixed Dollar Deductibles per Calendar Year

Health insurance policies often use a ***fixed dollar deductible per calendar year***, which is similar to the overall deductible for major medical insurance. The fixed dollar deductible per calendar year can have an amount for an individual coverage, and then another amount for the family coverage. The insurance coverage will kick in when **either** the individual's deductible or the family deductible has been met.

For example, a family of five (Dad, Mom, Anne, Chase, and Chloe) purchases a health insurance policy, which has a $100 deductible per person per year and a $250 deductible for the family per year. If Dad incurs a loss of $70, then Chloe a $110 and a $90, and then Anne a $180, the family will pay

- $70,
- $100 (Chloe's deductible met),
- $0, and
- $80 (family deductible met).

or a total of $250, while the insurer will pay 0 + 10 + 90 + 100 = $200.

This type of deductible is rarely used outside of health insurance and medical expense insurance.

Elimination Periods

In workers compensation, disability benefits coverage typically has an ***elimination period***, which is the period of time between the date of a disability/accident and the date that benefits begin. During the elimination period, the insured does not receive any disability benefits. However, if the disability continues for a certain length of time, the benefits are paid retroactively for the elimination period. The period before benefits are paid retroactively is called the ***retroactive qualification period***. If the retroactive qualification period is the same as the elimination period, then the policy will, in effect, have a franchise deductible.

Objectives of Deductibles

Here are a few reasons to apply deductibles to insurance policies:

- Deductibles eliminate claims for small losses, thus reducing the associated expenses.
- The average claim payment is reduced for large losses, which can lower premiums, making insurance more affordable (or attractive to potential buyers).
- Policyholders tend to be more cautious because deductibles introduce financial responsibility.
- When the value of the insurance coverage is not as good, policyholders can choose to have a higher deductible, which will reduce their premiums.

However, deductibles can also cause a few unwanted issues:

- Policyholders may be disappointed that claims are not paid in full.
- Marketing of insurance coverage gets complicated with deductibles.
- Insureds may inflate the claim to recover the deductible.

Example S1.2.1.1

Dorothy purchased an insurance policy from Proteger Casa Insurance Company. During the policy term, she incurred a loss of 2,350.

Calculate the payout of the policy if the policy has

1. an ordinary deductible of 500.
2. a fixed percentage deductible that is 30% of the loss, with a floor of 500.
3. a disappearing deductible that is 500 for losses below 2,000, decreases linearly for losses between 2,000 and 3,000, and 0 for losses above 3,000.
4. a franchise deductible of 500.

Solution to (1)

Apply $(\mathrm{S}1.2.1.1)$. Since the loss exceeds the deductible, the insurer pays the excess loss amount:

$$Y = 2{,}350 - 500 = \mathbf{1{,}850}$$

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Solution to (2)

Apply $(\mathrm{S}1.2.1.2)$ and $(\mathrm{S}1.2.1.3)$. Since $0.3(2{,}350) = 705 > 500$, the effective deductible is 705 and the claim payment is

$$Y = 2{,}350 - 705 = \mathbf{1{,}645}$$

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Solution to (3)

Apply $(\mathrm{S}1.2.1.5)$. Since $2{,}000 < 2{,}350 < 3{,}000$, use the third piece of the equation. The claim payment is

$$\begin{aligned} Y &= 2{,}350 - 500\left(\frac{3{,}000 - 2{,}350}{3{,}000 - 2{,}000}\right) \\ &= \mathbf{2{,}025} \end{aligned}$$

Solution to (4)

Apply $(\text{S}1.2.1.6)$. Since the loss exceeds the deductible, the insurer pays the entire loss amount:

$$Y = \mathbf{2{,}350}$$

Example S1.2.1.2

You are given claim information for a policy with a linearly disappearing deductible:

Claim Amount	Payment
200	0
750	600
900	800
1,300	1,300

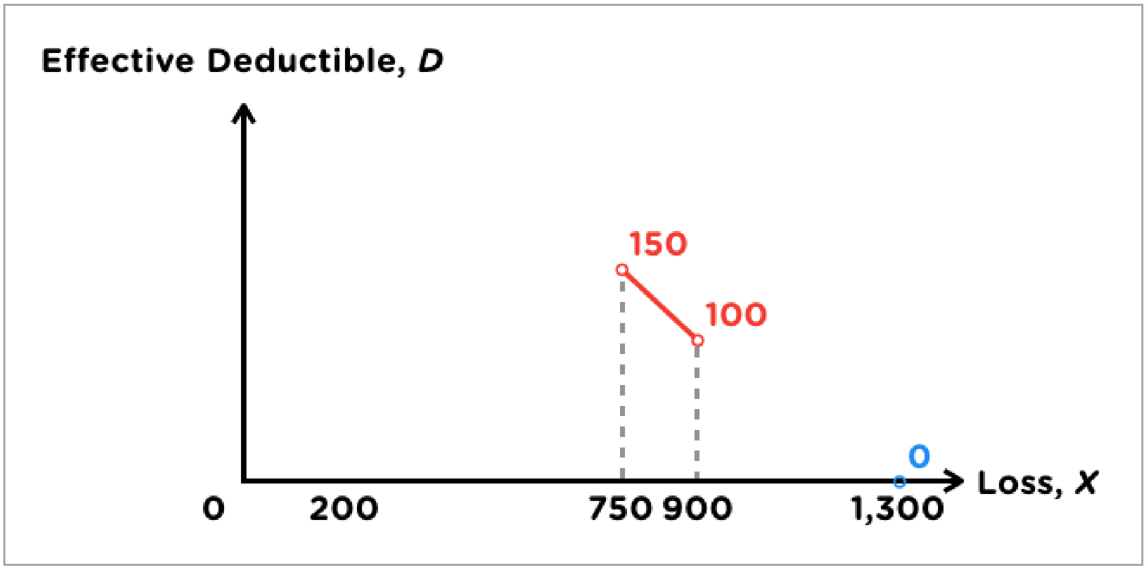
Calculate the payment for a claim of size 1,000.

Solution

From the claims given, we can calculate the effective deductible for each claim.

Claim Amount	Payment	Effective Deductible
200	0	$\geq$ 200
750	600	150
900	800	100
1,300	1,300	0

Note that for claim amount 200, the effective deductible is at least 200.



We know that the second and third claims are in the range of the loss of the disappearing deductible, but we are unsure if 1,000 is within this range. To check this, we first calculate b, the upper bound of the range, using linear interpolation. Note that the effective deductible is 0 at the upper bound.

$$\frac{900-750}{100-150} = \frac{b-900}{0-100}$$
$$-3 = \frac{b-900}{-100}$$
$$b = 1{,}200$$

Now, it is evident that $1{,}000 < b$. Thus, the effective deductible for a claim of 1,000 is:

$$\begin{aligned}\frac{900-750}{100-150} &= \frac{1{,}000-900}{D-100} \\ -3 &= \frac{100}{D-100} \\ D-100 &= -33.3333 \\ D &= 66.6667\end{aligned}$$

Thus, the payout is $1{,}000 - 66.6667 = \mathbf{933.3333}$.

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Policy limits

A ***policy limit*** is the maximum amount the insurer will pay for a single loss.

For a policy that has a policy limit of u, the insurer pays the full loss amount for a loss (X) that is below u, and only u for a loss that exceeds u.

$$Y = \min(X, u) = \begin{cases} X, & X \le u \\ u, & X > u \end{cases} \tag{S1.2.1.7}$$

A policy can have multiple limits, and there is more than one way to specify the limit. For example, on a homeowners insurance policy, the dwelling coverage is limited by the dwelling's value or the insured amount. The content coverage limit is a percentage of the dwelling limit. There is a defined limit for liability coverage, as well as inside limits for personal property like jewelry, silverware, art, etc.

Objectives of Policy Limits

Here are a few reasons for applying limits to insurance policies:

- A policy limit clarifies the financial obligation of the insurer.

- It also reduces the risk assumed by the insurer because it acts as an upper bound on the payment amount. This reduces the probability of insolvency.
- Limits allow policyholders to choose the coverage that works best for them, as lower limits result in lower premiums.

Coach's Remarks

A policy limit is the opposite of a deductible. If a policy has a policy limit of u, the insured's payment is

$$\text{Insured's Payment} \;=\; \max(0,\, X-u) \;=\; \begin{cases} 0, & X \le u \\ X-u, & X > u \end{cases}$$

which looks like an insurer's payment for a policy with a deductible of u.

The payments from both the insurer and the insured should always sum to the full loss amount.

$$\begin{aligned} \text{Insurer's Payment} + \text{Insured's Payment} &= \begin{cases} X, & X \le u \\ u, & X > u \end{cases} + \begin{cases} 0, \\ X-u, \end{cases} \\ &= \begin{cases} X+0, & X \le u \\ u+X-u, & X > u \end{cases} \\ &= \begin{cases} X, & X \le u \\ X, & X > u \end{cases} \\ &= X \end{aligned}$$

Coinsurance

Coinsurance is the proportion of loss the insurer is responsible for.

For a policy that has coinsurance of $100\alpha\%$, the insurer's payment for a loss of size X is

$$Y = \alpha X \tag{S1.2.1.8}$$

Coach's Remarks

Coinsurance is essentially a fixed percentage deductible, but from the insurer's perspective. For example,

- 40% **coinsurance** means the insurer is responsible for 40% of the loss, and the insured 60%;
- 40% **deductible** means the insured is responsible for 40% of the loss, and the insurer 60%.

Coach's Remarks

On the exam, if the term **coinsurance** is used on its own, then it refers to the coverage modification we just discussed. If the term **coinsurance clause** is used, then it refers to the coinsurance provision in homeowners insurance.

When all three common coverage modifications (i.e., ordinary deductible d, policy limit u, and coinsurance α) are present, the claim payment has the following structure.

$$Y = \begin{cases} 0, & X \leq d \\ \alpha\,(X - d), & d < X \leq m \\ u, & X > m \end{cases} \tag{S1.2.1.9}$$

where $m = \dfrac{u}{\alpha} + d$ is the ***maximum covered loss***. The maximum covered loss is the loss above which no additional benefits are paid. In other words, the maximum covered loss is the smallest loss amount for which the insurer pays the policy limit.

To modify (S1.2.1.9) for any combination of coverage modifications,

- set $d = 0$ if there is no deductible,
- set $u = \infty$ if there is no policy limit, and
- set $\alpha = 1$ if there is no coinsurance.

Coach's Remarks

The payment structure above assumes the coinsurance only kicks in after the deductible is met, which is the default.

In the rare case where the question specifies the coinsurance applies before the deductible is met, that means only $100\alpha\%$ of the insured's payment (i.e., the insurer's responsibility if the deductible was absent) goes towards meeting the deductible. In that case, the deductible is met when the loss reaches $d^* = \frac{d}{\alpha}$.

In terms of claim payment, in the insurer's eyes, a policy with coinsurance α that is applied **before** the deductible d is met is equivalent to a policy with coinsurance α that is applied **after** the deductible d^* is met.

$$Y = \begin{cases} 0, & X \le d^* \\ \alpha\left(X - d^*\right), & d^* < X \le m \\ u, & X > m \end{cases}$$

where $m = \dfrac{u}{\alpha} + d^*$.

Example S1.2.1.3

For an insurance policy:

- The policyholder is fully responsible for claims below 200.
- The policy will reimburse 80% of claims in excess of 200.
- The insurance payment is capped at 2,000.

Calculate the insurance payment for a claim of 2,100.

Solution

The three bullets imply that the insurance policy has a deductible of 200, a coinsurance of 80%, and a policy limit of 2,000. The maximum covered loss is

$$\frac{2{,}000}{0.8} + 200 = 2{,}700$$

Since the claim amount is between the deductible and the maximum covered loss, calculate the insurance payment using the second piece in (S1.2.1.9).

$$0.8\,(2{,}100 - 200) = \mathbf{1{,}520}$$

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Example S1.2.1.4

An insurance policy pays for the full amount of losses that exceed 500, up to a maximum payment of 1,500.

Calculate the insurance payment for a claim of 2,100.

Solution

The policy has a franchise deductible of 500 and a policy limit of 1,500. Because the policy pays the full loss above the deductible, the maximum covered loss is 1,500, not 2,000.

Since the claim exceeds the maximum covered loss, the insurance payment is capped at the policy limit, or $\mathbf{1{,}500}$