Chapter 1.1

Cash-flow timelines and perspective

From *Credit Products Playground*, with changes after version 0.4.0, not yet released. Interactive version: https://danieltuzes.github.io/credit-and-derivatives/foundations/cash-flow-timelines/

1.1.1 What you will be able to do

After this lesson, you should be able to:

- read an ordered schedule of payment amounts and times;
- state the time unit and the time origin of a timeline;
- apply a consistent sign convention from a named perspective.

1.1.2 Start with events, not formulas

A financial calculation begins with a list of events. The valuation-time, written 0, is the origin of every time in this lesson. The local payment-index k identifies one row. The index is not a time or a date. At row k, write the signed-cash-flow as CF_k and its payment-time as t_k. Row k pairs one amount with one time:

$$CF_k \quad \text{occurs at} \quad t_k \tag{1.1.1}$$

The shared subscript k pairs each amount with its time. The amount, the time, and the row index still have different meanings.

Example 1.1.1: Reading cash-flow timelines

Read a timeline

Suppose, in a simplified primary-issuance example, a bondholder pays an issuer USD 980 now, receives USD 30 after one year, and receives USD 1,030 after two years.

Payment index k	Payment time t_k, years from time 0	Signed cash flow CF_k, USD	Event
0	0	-980	Purchase price paid
1	1	+30	Coupon received
2	2	+1,030	Coupon and principal received

This table does **not** say whether USD 980 is a fair price. It only describes who exchanges what, and when.

Reverse the perspective

From that issuer's perspective, every amount above changes sign:

Time	Bondholder	Issuer
0 years	USD -980	USD +980
1 year	USD +30	USD -30
2 years	USD +1,030	USD -1,030

Changing the perspective does not change the dates or the absolute values of the amounts. Cash flows from opposite perspectives must be converted to one perspective before they are added. Otherwise the sum mixes two different models.

Same amount, different time

USD +100 at $t_1 = 0.5$ years and USD +100 at $t_2 = 2$ years are two distinct events. The amounts match; the times do not. A later lesson introduces the discount factors needed to compare them at time zero.

1.1.3 Check your understanding

These direct and transfer items cover reading a schedule and reversing perspective. Each question stays collapsed until you open it; answers and explanations appear once you check.

Knowledge check 1.1.1: Cash-flow timelines

1. From a holder's perspective, a timeline is measured in years from valuation time 0 and shows USD +25 at t = 1 and USD +100 at t = 2. Which reading is correct?
   (a) The USD 25 receipt occurs after one year and the USD 100 receipt after two years
   (b) The USD 100 receipt occurs after one year and the USD 25 receipt after two years
   (c) Both cash flows occur at valuation time
2. Time is measured in years from valuation time 0. Where does a payment scheduled 18 months later belong?
   (a) t = 0.5
   (b) t = 1

(c) t = 1.5

3. Use the convention that inflows are positive and outflows are negative. From an investor's perspective, how is principal received at maturity signed?

   (a) Positive
   (b) Negative
   (c) It has no sign

4. Use the convention that inflows are positive and outflows are negative. From an issuer's perspective, how is a coupon paid to investors signed?

   (a) Positive
   (b) Negative
   (c) It has no sign

Answers: *end of the chapter.*

1.1.4 Model boundary and review note

The times in this lesson are inputs, measured in years. Real schedules require calendar dates, business-day adjustments, and year-fraction conventions; none is inferred in this lesson.

The dated-schedule and timeline treatment here follows Tuckman & Serrat[1]. Reversing the holder's perspective changes the sign of every cash flow. This is a bookkeeping convention, not a claim from one source page. The lesson stays `draft` pending human confirmation of the printed locators.

References

[1] Tuckman & Serrat, Fixed Income Securities: Tools for Today's Markets (4th ed., 2022). §1.1, the dated coupon schedule in Table 1.1; §1.6 and Figure 1.3, a timeline of dated events and day-count intervals.

Notation

k **Payment index**. Labels one row in the ordered cash-flow schedule. The index is an ordering label; the associated payment time is measured in years.

$$k \in \{0, 1, 2, ...\}$$

t_k **Payment time**. Time from the valuation date to one scheduled cash-flow event; a time coordinate, not a calendar date or payment index. *Units:* years from the valuation date.

CF_k **Signed cash flow**. Amount received or paid at one event from the stated holder perspective; positive means received and negative means paid by that holder. *Units:* stated currency units.

0 **Valuation time**. Common origin from which later model times and present values are measured. *Units:* years from the valuation date.

Answers to the knowledge checks

Knowledge check 1.1.1: Cash-flow timelines

1. **(a)** The USD 25 receipt occurs after one year and the USD 100 receipt after two years. Each amount is paired with its stated time measured from valuation time 0.
2. **(c)** t = 1.5. Under the stated units, 18 months is 1.5 years after valuation time.
3. **(a)** Positive. Principal received is an inflow to the investor, so it is positive under the stated convention.
4. **(b)** Negative. A coupon payment is an outflow from the issuer, so it is negative under the stated convention.