Relation between Scoring-Parameters

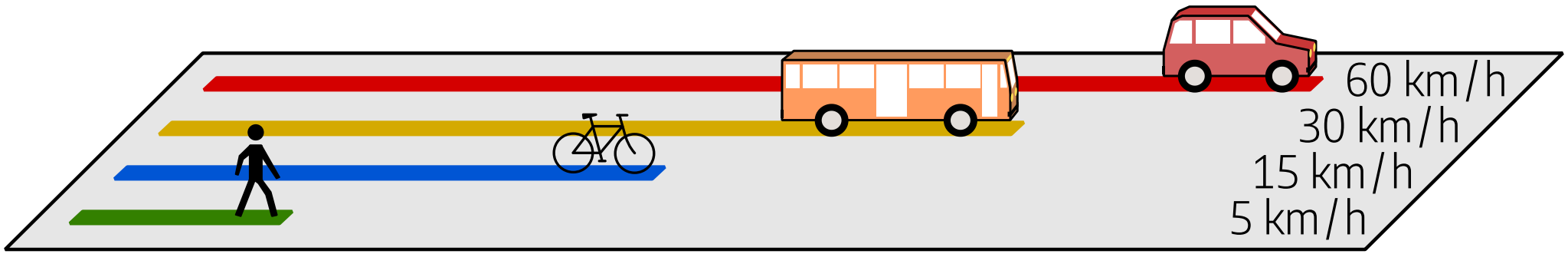
The various scoring parameters, especially for legs, can be a bit intimidating.

The following slides try to give a few ideas how one can try to interpret the various parameters and get a better understanding of their relation to each other.

Leg Scoring-Parameters

Let's assume we have 4 different modes: `walk`, `bike`, `pt`, `car`.

Let's assume an average speed for each mode*.

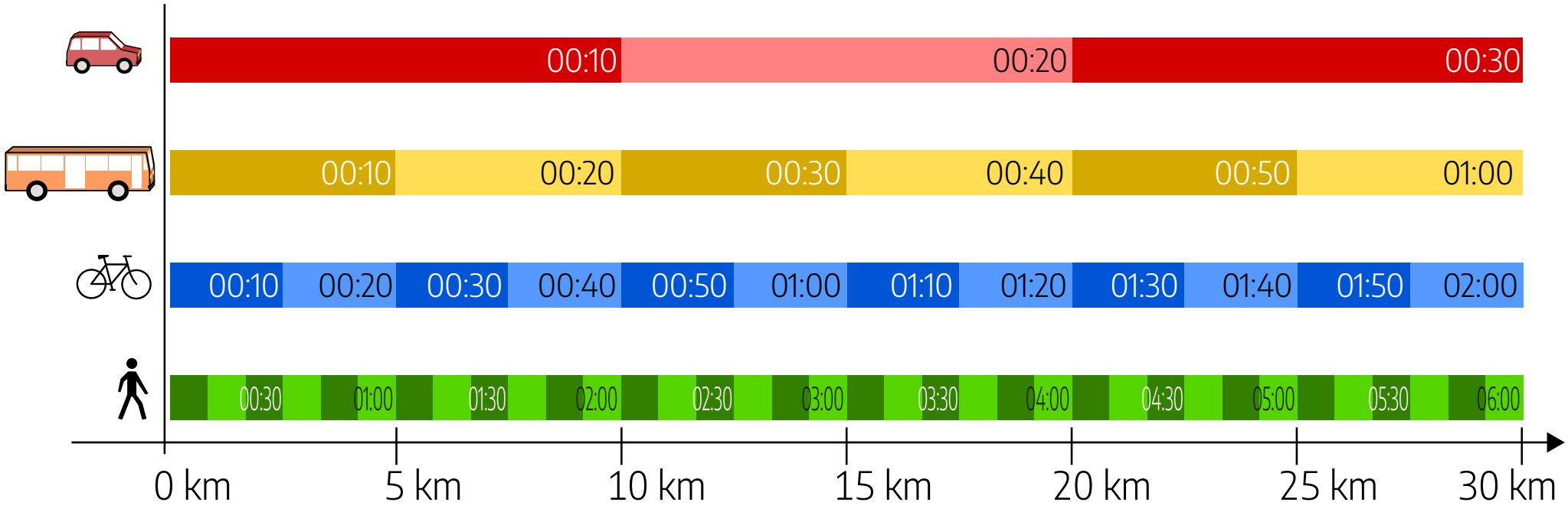


* In reality, the average speeds are dependent on the distance. Walking or cycling a long distance will result in a slower average speed than for a shorter distance. But travelling a longer distance with car or pt will result in a higher average speed, as motorways or faster long-distance trains can be used than for shorter distances.

To keep the example simple, we stick with constant speeds per mode.

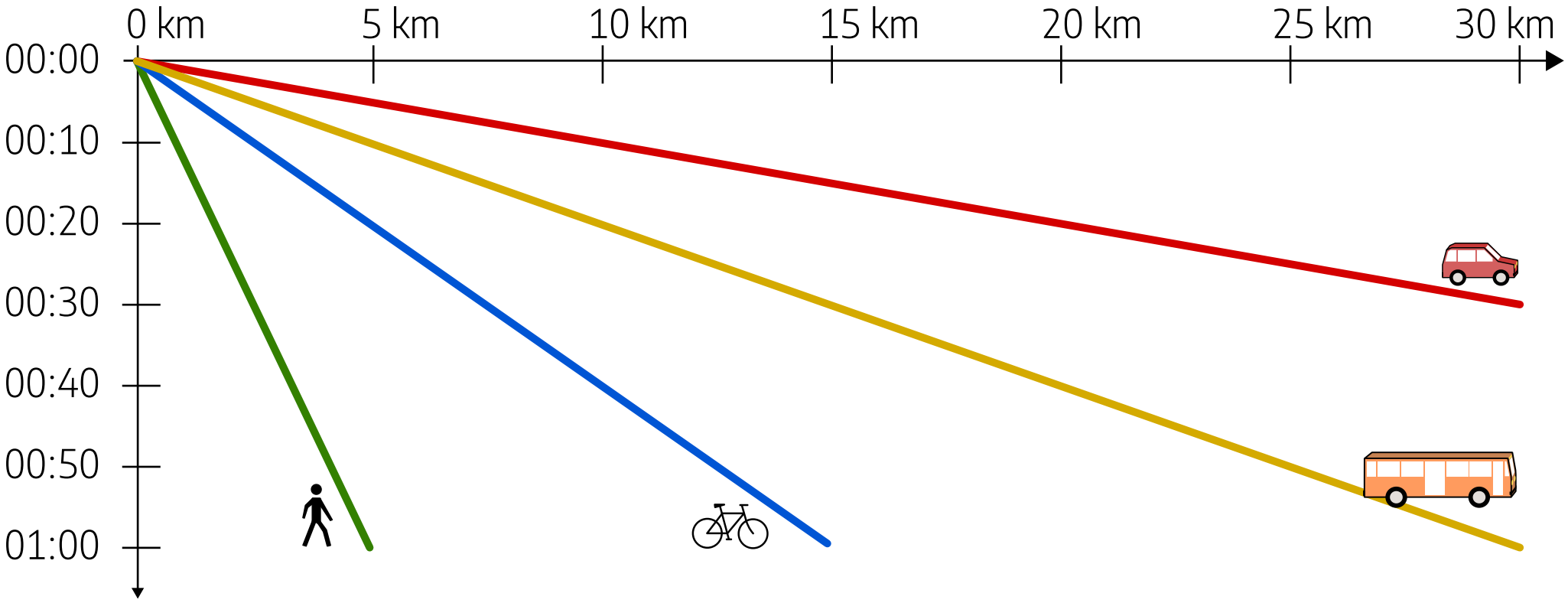
Leg Scoring-Parameters

We can plot how long it takes to travel specific distances for each mode:



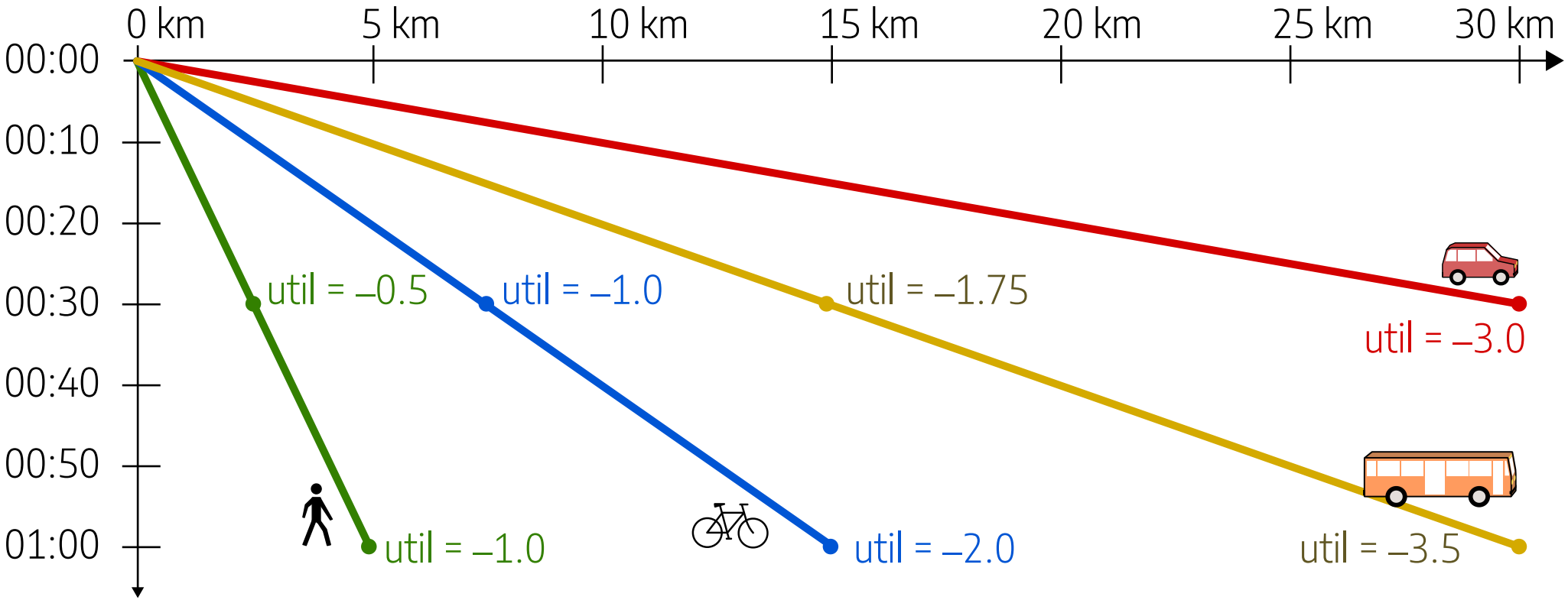
Leg Scoring-Parameters

We can also plot it in a space-time diagram:



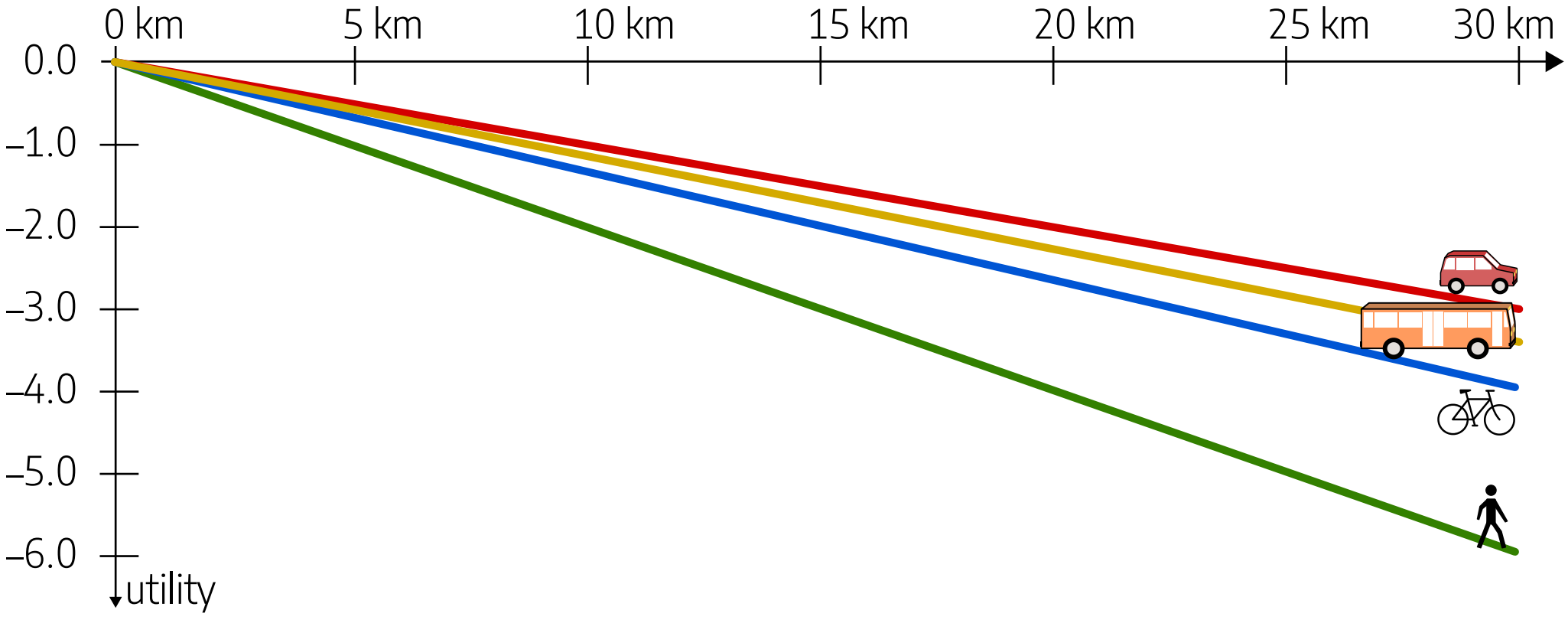
Leg Scoring-Parameters

Let's assume **marginal utilities by hour** for each mode:
`car` = –6.0, `pt` = –3.5, `bike` = –2.0, `walk` = –1.0
Now we can calculate how much (dis-)utility an agent receives for travelling a certain distance or time:



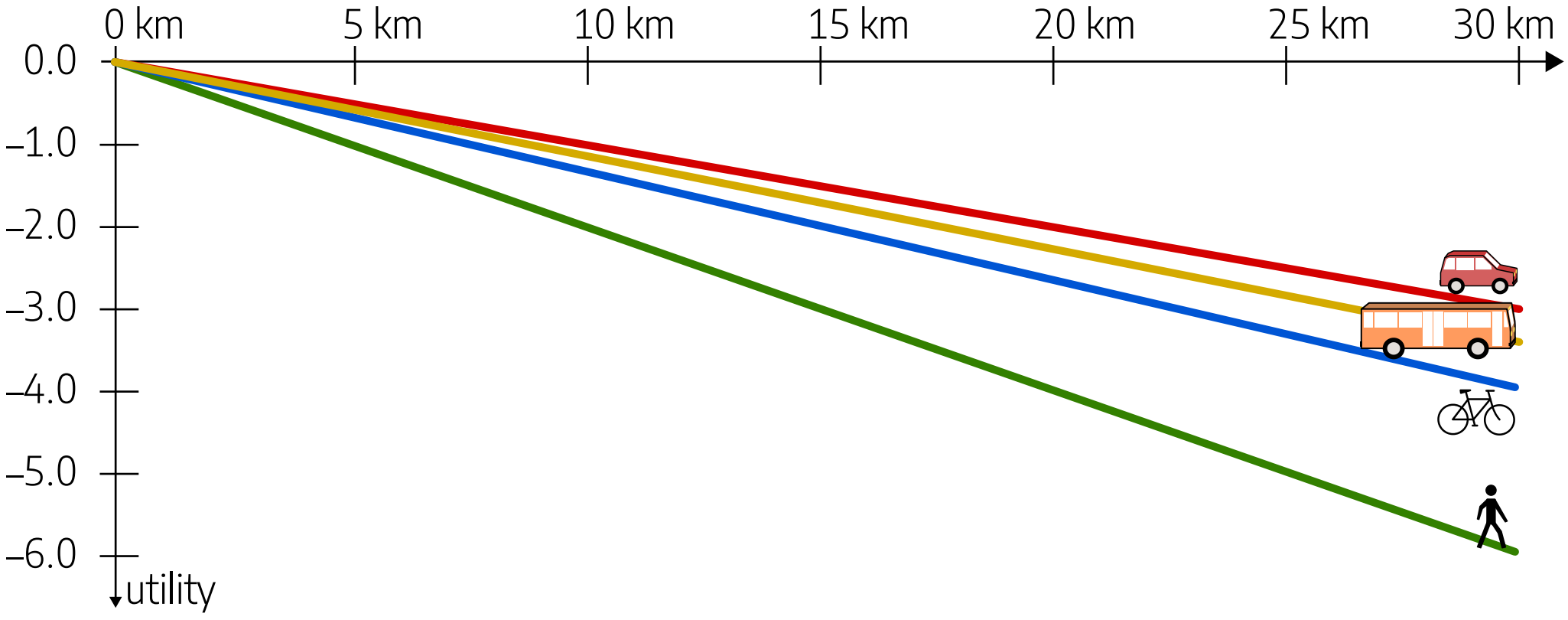
Leg Scoring-Parameters

Instead of plotting time-by-distance as before, we can now plot utility-by-distance:



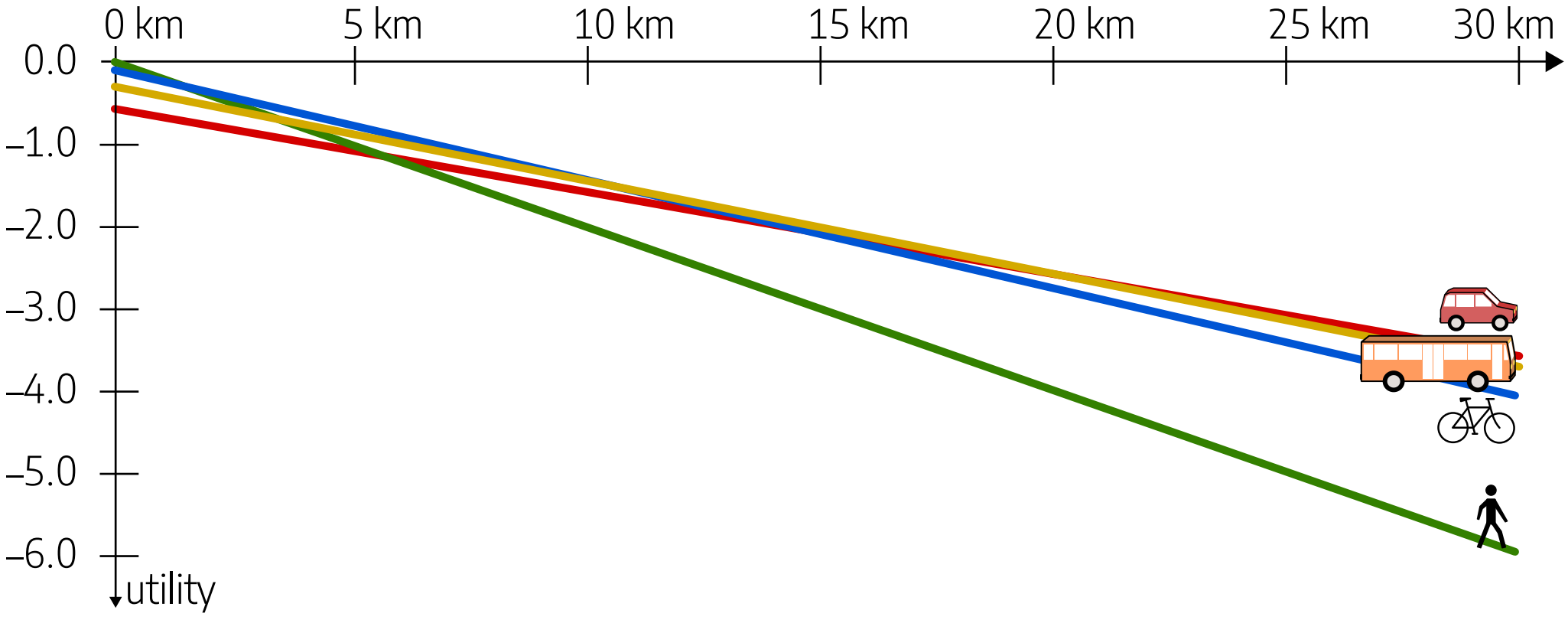
Leg Scoring-Parameters

What mode would be best for a leg with a distance of 6 km?
Based on the chart, using `car` would always result in the smallest disutility for a leg for a given distance.
Thus the agent would always choose `car` no matter how long the leg is.



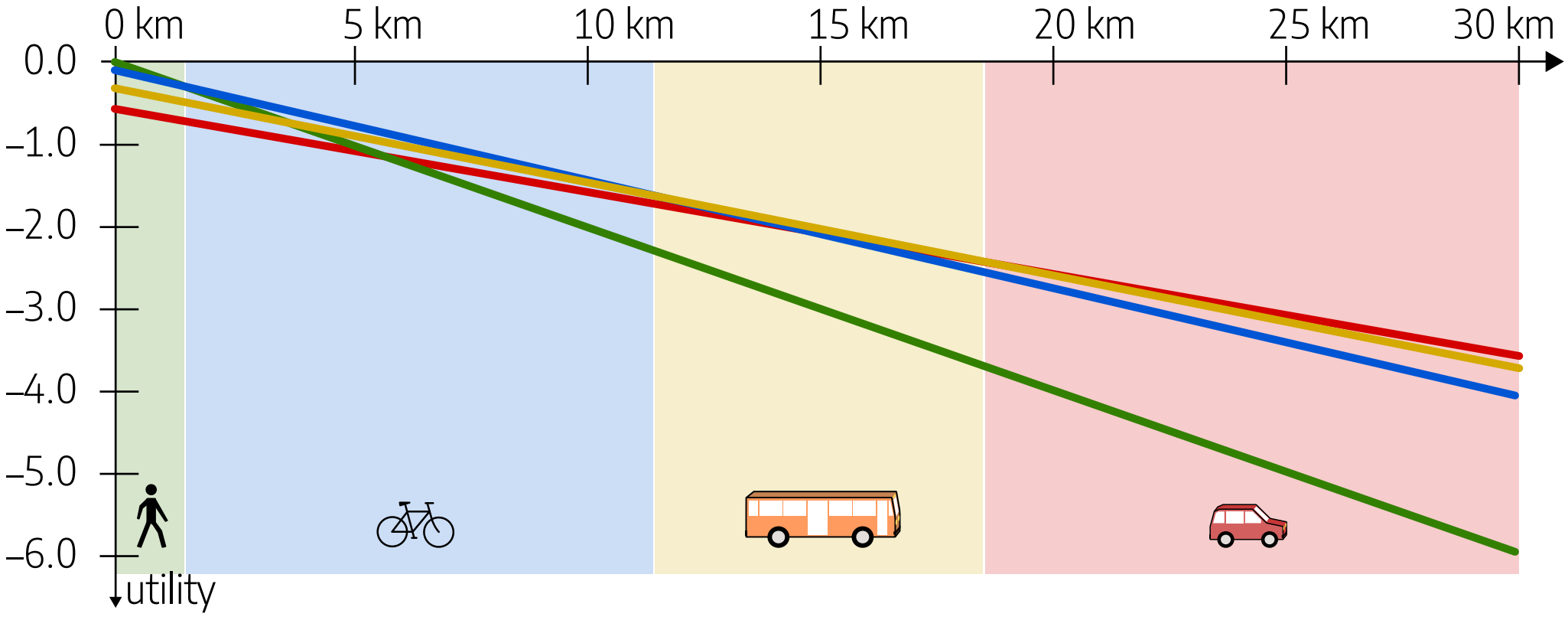
Leg Scoring-Parameters

Let's add **mode-specific constants**:
`car` = –0.6, `pt` = –0.3, `bike` = –0.1, `walk` = 0.0
Now the lines intersect at different distances.



Leg Scoring-Parameters

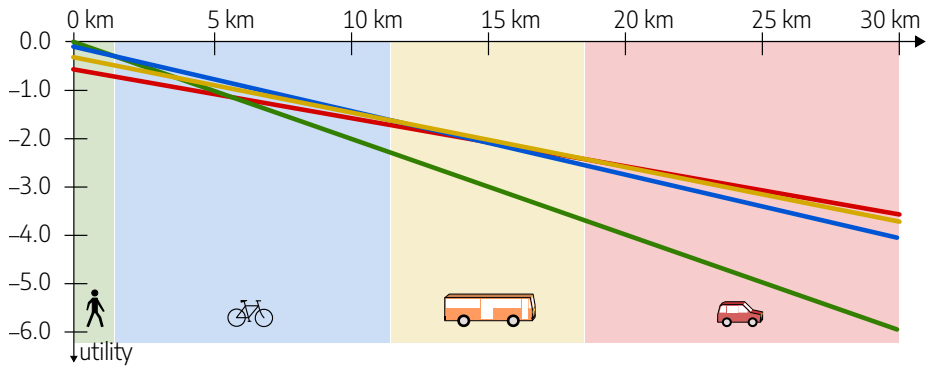
Up to 1.5 km, `walk` is the cheapest option. From 1.5 km up to 12 km, `bike` is the best option.
From 12 km to 18 km, `pt` is the best option. For distances longer than 18 km, `car` is the best option.



Leg Scoring-Parameters

Scoring-Parameters:

	car	pt	bike	walk
marginal utility / hour	–6.0	–3.5	–2.0	–1.0
constant	–0.6	–0.3	–0.1	0.0



Changing the marginal utilities controls the gradient of the lines,
while changing the constant part controls the offset.
By changing the parameters, the intersection points can be influenced.
By shifting the intersection points, mode choice can be influenced in MATSim.

In MATSim, modes are typically not optimized for each individual leg, but all legs in a tour get the same mode. Thus, agents might still choose `car` or `pt` for short distances, or `bike` for longer legs, when they are combined with other legs in a tour.

Interpretations of the Leg Scoring-Parameters

walk
You can immediately start walking → constant(walk) = 0.0.

car
To drive a car, you first need to walk to the location the car is parked, unlock it, get in, start it. Upon arrival, you need to find a parking lot, park, and get off. This all uses time. This can be modelled with the constant. Let's assume this takes about 6 minutes in total, or 1/10th of an hour.
constant(car) = 1/10 * marginalutility(car) → constant(car) = -0.6

pt
Travelling with public transport usually takes a bit longer than travelling with a private car, but the time can be used to do other things (e.g. reading a news paper or a book). So the value of travel time (= the marginal utility) should be less for public transport than for car.
→ marginalutility(pt) = –3.0

Interpretation of Public Transport Scoring-Parameters

`utilityOfLineSwitch` sets the (dis)utility for transfers on a public transport trip.

Example: There are 2 options to travel from A to B:

- A direct bus that takes 30 minutes in total.
- A first bus for 10 minutes, then a second bus for another 10 minutes, with 5 minutes in-between to transfer.

Surveys regularly show that people prefer the direct bus, even if it is slower, because the transfer is seen as uncomfortable and represents a potential risk for the trip.
The `utilityOfLineSwitch` can reflect this discomfort.

Assume surveys show that people prefer a direct connection over a transfer, if it is at most 10 minutes slower. In this case, `utilityOfLineSwitch` should correspond to 1/6th of the marginal utility of travelling with pt. (10 minutes = 1/6th of an hour)
→ `utilityOfLineSwitch` = 1/6 * (–3.0) = –0.5

Additional Scoring Parameters

The scoring configuration allows for additional parameters, e.g. marginal-utility per meter travelled, daily constants (as opposed to constants per leg), or how monetary costs (e.g. toll costs) should be taken into account.

These additional parameters essentially also influence the gradients of the curves and thus the intersection points between the different modes.

In reality, the curves also won't be straight lines, as the assumed speeds for the modes are not constant. Instead, they depend on the distance: For longer trips, car and public transport likely have a higher average speed as motorways or faster long-distance trains can be used.

But despite the simplifications, it hopefully still helps to better understand how the different parameters are in relation to each other, what influence they have, and how they can be used to control the modal split of a simulation.