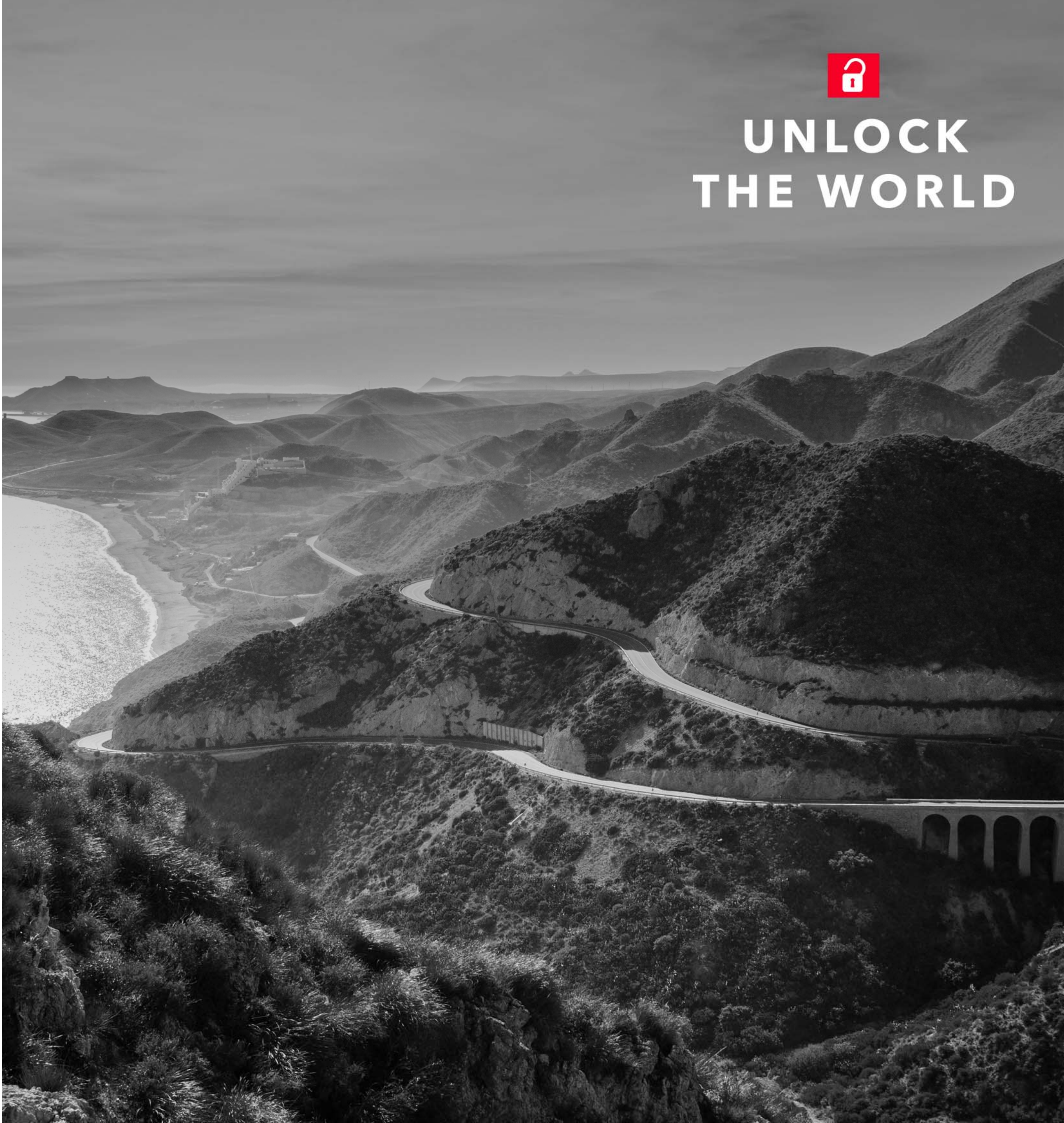

The World's Best Driving Road

AVIS® We try harder®

1. The Avis Driving Ratio

For a great drive you need a road with the right balance of tight corners and long steady stretches. The straight sections give you the relaxation and the view, while the tight corners restrict your speed and require driving skills to negotiate. To slow for a corner you need braking deceleration, a_b; lateral acceleration, a_l, which holds the car on the road round the bend; and then straight-line acceleration, a_f, as you move back up to cruising speed. The bends also give a change of view. It is the balance, or ratio, that characterises the drive.

I will introduce the Avis Driving Ratio, ADR, in terms of the time going round bends, t_b, and the time cruising, t_s:

$$ADR = \frac{t_s}{t_b} \tag{1}$$

The value you will look for is down to personal choice. For example, a ratio of 3 is quite demanding: 3 seconds to go round a slow corner, 10 seconds to accelerate to cruising speed, take a breath and brake ready for the next one. A ratio of 10 to 20 may suit most enthusiastic drivers, while a family may prefer an ADR ratio of 100. That's 6 seconds going round a corner and 5 minutes cruising, taking in the scenery before the next corner approaches

Driver	ADR	Cornering	Cruising
Very demanding	1-3	3 seconds	10 seconds
Enthusiastic	10-20	4 seconds	40 seconds
Family	100+	6 seconds	5 minutes

2. The Car

Just what is a tight corner? For the ADR equation, it is a corner that requires you to slow down significantly below your cruising speed. If it is more of a gentle curve then you just steer round it on cruise control. Whilst this can depend on the road, it also depends on the vehicle. It is the combination of the lateral acceleration, braking deceleration and straight line acceleration characteristics of a vehicle that determine how it can weave and sprint on any particular road.

The maximum speed, v_{max}, that you can take a corner is limited by the lateral acceleration through the equation of centripetal force:

$$a_l = \frac{{v_{max}}^2}{r} \quad or \quad v_{max} = \sqrt{r\,a_l} \qquad (2)$$

We can convert that to a time, t_b, and also calculate the distance of the curve, s_b, to give:

$$s_b = \frac{\pi r}{2} \quad t_b = \frac{\pi}{2}\sqrt{r/a_l} \qquad (3)$$

Equation (3) is for a right angle, but uses scientific SI units, so here is a convenient table with some examples:

	Lateral Acceleration/ g force	speed /mph	Radius of curve, r /metres	t /secs
Leisurely				
	0.1	70	1000	50
	0.1	50	500	35
	0.1	30	180	20
	0.1	10	20	7
At the limit				
	0.5	70	200	10
	0.5	50	100	7
	0.5	30	40	4
Formula One				
	5	150	90	2.1
	5	100	40	1.4
	5	70	20	1.0
	5	50	10	0.7

Table 1: Examples of accelerations and cornering speeds for different driving experiences

You might choose to relate r to the radius (half the width) of a roundabout. For the road to give a good driving experience it has to have corners that slow you down below your cruising speed – that depends on the car and your driving style.

3. The Straight

The straight is *relaxation with thrills.* The driver takes the car out of the corner and accelerates up to cruising speed, holds that speed for as long as possible and breaks hard for the next bend. That gives three formulae for the time and distance of each section:

Acceleration:

$$s_1 = \frac{v_c^2 - v_1^2}{2a} = \frac{v_c^2 - ra_l}{2a} \quad t_1 = \frac{v_c \ - \sqrt{ra_l}}{a} \tag{4}$$

Braking:

$$s_3 = \frac{v_c^2 - v_1^2}{2a_b} = \frac{v_c^2 - ra_l}{2a_b} \quad t_3 = \frac{v_c \ - \sqrt{ra_l}}{a_b} \tag{5}$$

Cruising is what is left:

$$s_c = l - s_1 - s_3 \quad t_c = s_c/v\_c \tag{6}$$

The last bit is more complicated if we expand it:

$$t_2 = \left\{ l - \frac{1}{2}(v_c^2 - r\, a_l)\left(\frac{1}{a} + \frac{1}{a_b}\right) \ \right\}/v_c \tag{7}$$

Total time on the straight is the sum of $t_1, t_2 \ and \ t_3$

$$t_s = \frac{l}{v_c} + \frac{1}{2v_c}\left(v_c - \sqrt{r\, a_l}\right)^2 \ (\frac{1}{a} + \frac{1}{a_b}) \tag{8}$$

ACCELERATION

RADIUS OF BENDS

LENGTH OF STRAIGHTS

Which we can then use to work out the
Avis Driving Ratio:

$$ADR = \frac{1}{\pi v_c}\sqrt{\frac{a_l}{r}}\left(2l + \left(v_c - \sqrt{r\,a_l}\right)^2\left(\frac{1}{a} + \frac{1}{a_b}\right)\right) \tag{9}$$

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4. Examples

Consider a middle example from the table above. Driving at the limit and coming out of a 100m radius right-angle bend. That took 7 seconds. With an ADR of 10, we want a 70 second straight driving before the next bend. Now the other two accelerations come into effect. The normal (0 to 60) acceleration is relatively low for a road car – the lateral and breaking forces are much larger. For example 0-60 in six seconds is an average of 0.5g, while reasonable brakes would give 1g. This gives a relaxing 10:1 Avis Driving Ratio and needs a 1070m length of straight (that's one km between bends. As you can see a 1:1 ratio would spend just 3 seconds on the straight – that would all be spent accelerating hard and immediately braking hard for the next bend. You will get that sort of drive when the bends are about 70m apart.

	Speed mph	Time seconds	Distance metres
Start	50	0	
Accelerates	70	2	50
Cruising	70	32	1000
Braking	50	1	20

Table 2: on Example of an ADR of 10 a straight stretch of road:

These are the numbers, but what is your favourite road?