ATAR allocation and participation rates

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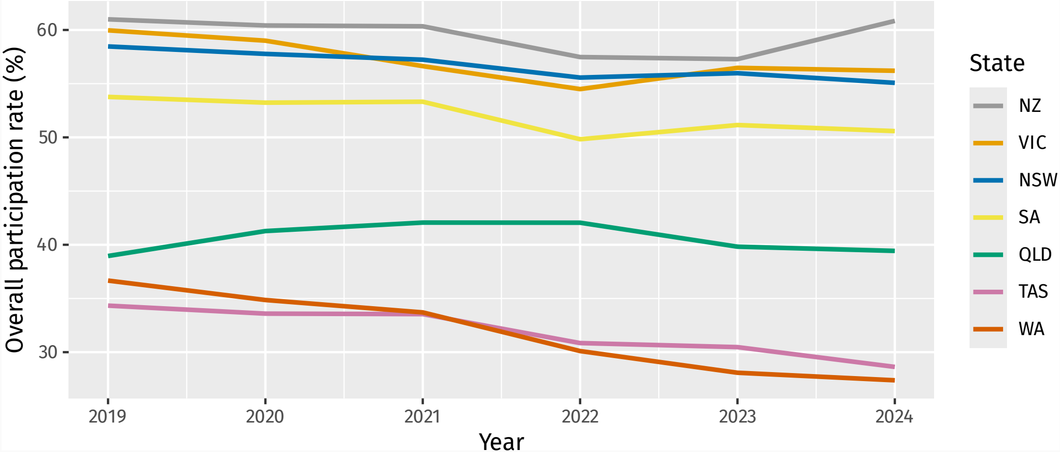
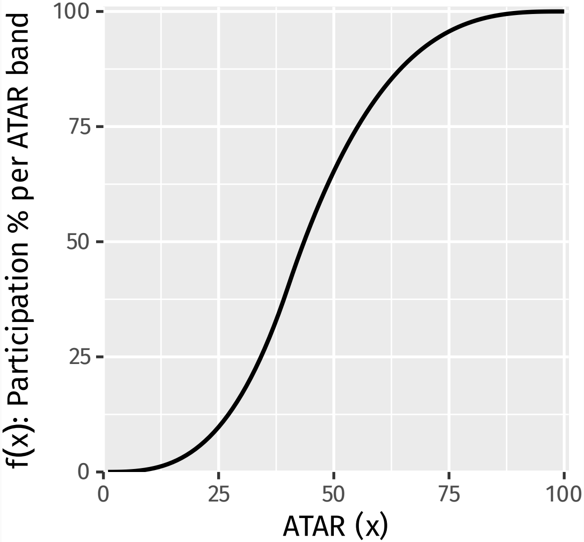
Not everyone gets an ATAR



Overall participation rate: p = % students in cohort eligible for an ATAR

Participation curve



- More academically able students are more likely to participate
- $f(x)$ = participation rate of people in cohort *who would have got an ATAR of x*
- Area under curve = p (overall participation rate)
- N = total eligible students
- Number of students allocated ATAR of x should be $f(x)/100 \times N/2000$

Participation curves (logistic)

Prior to 2015, most states used a logistic curve (due to Tim Brown):

$$f_{a,b}(x) = \frac{100}{1 + exp(-a - bx)}$$

- $f_{a,b}(x)$ = participation % per ATAR band x
- a and b chosen for each state, partly based on NSW Year 10 achievement data, and partly subjectively
- Allows for differences between states other than overall participation rate

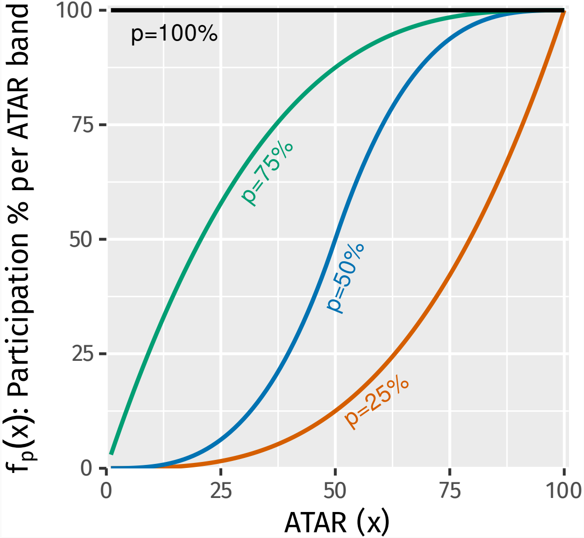
Participation curves (cubic spline)

In 2015, Ken Harrison proposed a cubic spline curve:

$$f_p(x) = \begin{cases} x^3/(150-2p)^2 & \text{if } 0 \le x \le 150-2p \\ 100-(100-x)^3/(2p-50)^2 & \text{if } 150-2p \le x \le 100 \end{cases}$$

- $f_p(x)$ = participation % per ATAR band x
- p is the participation rate (as a percentage)
- No parameters to be estimated
- Assumes participation rate only difference between states
- Closely matched logistic curves for most states in 2014
- Described in Harrison & Hyndman (2015)

Participation curves (cubic spline)



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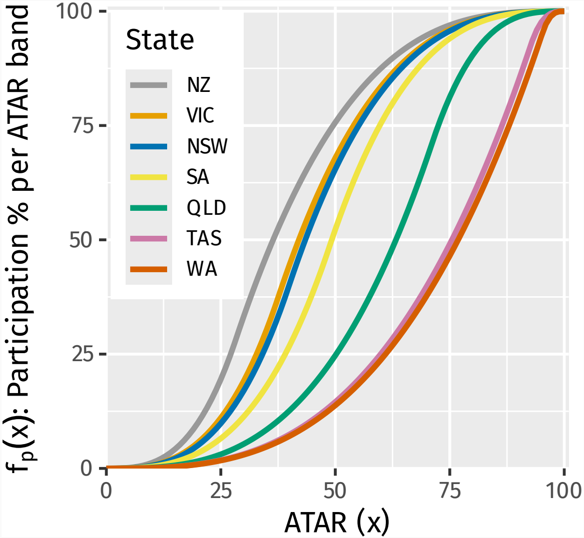

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Participation curves (cubic spline)

- Initially only Victoria adopted the cubic spline curve
- It has also been used to evaluate other states' curves for consistency since 2016.
- Gradually all states adopted the cubic spline curve
- Current annual evaluation is somewhat circular.
- It has not been evaluated against cohort performance data since Cooney (2015).

Cumulative constraints

- Number of students allocated ATAR of x should be $f_p(x)/100 \times N/2000$.
- Discrete scores mean that is not always possible.
- Instead, we can use cumulative constraints.

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Upper bound on total ATARs $\geq x$:

$$(N/p)\int_x^{100} f_p(u)du = \begin{cases} N\left[1 - \dfrac{x^4}{400p(150-2p)^2}\right] & \text{if } 0 \leq x \leq 150-2p \\ \dfrac{N}{p}\left[100 - x - \dfrac{(100-x)^4}{400(50-2p)^2}\right] & \text{if } 150-2p \leq x \leq 100 \end{cases}$$

N = total eligible students p = overall participation rate (as a %)
x = ATAR (0 to 100)

Mathematical details: cubic spline participation curve

$$f_p(x) = \begin{cases} x^{(100-p)/p} & \text{if } p < 25 \\ x^3/\alpha^2 & \text{if } 25 \leq p \leq 75 \quad \text{and} \quad 0 \leq x \leq \alpha \\ 100 - (100-x)^3/(100-\alpha)^2 & \text{if } 25 \leq p \leq 75 \quad \text{and} \quad \alpha < x \leq 100 \\ 100 - (100-x)^{p/(100-p)} & \text{if } p > 75 \end{cases}$$

- x = ATAR (0 to 100)
- p = overall participation rate (as a %)
- $\alpha = 150 - 2p$
- Curves go through $(0,0)$ and $(100,100)$
- Area under curve = p
- Continuous and monotonically increasing in both x and p
- For $25 \leq p \leq 75$, $f_p(x)$ is a cubic spline with a knot at (α, α)