

Today

- A “real-life” optimization problem starring
 - least squares fitting,
 - Hill functions,
 - exponential decay,
 - two very small people,
 - a very serious question about survival.

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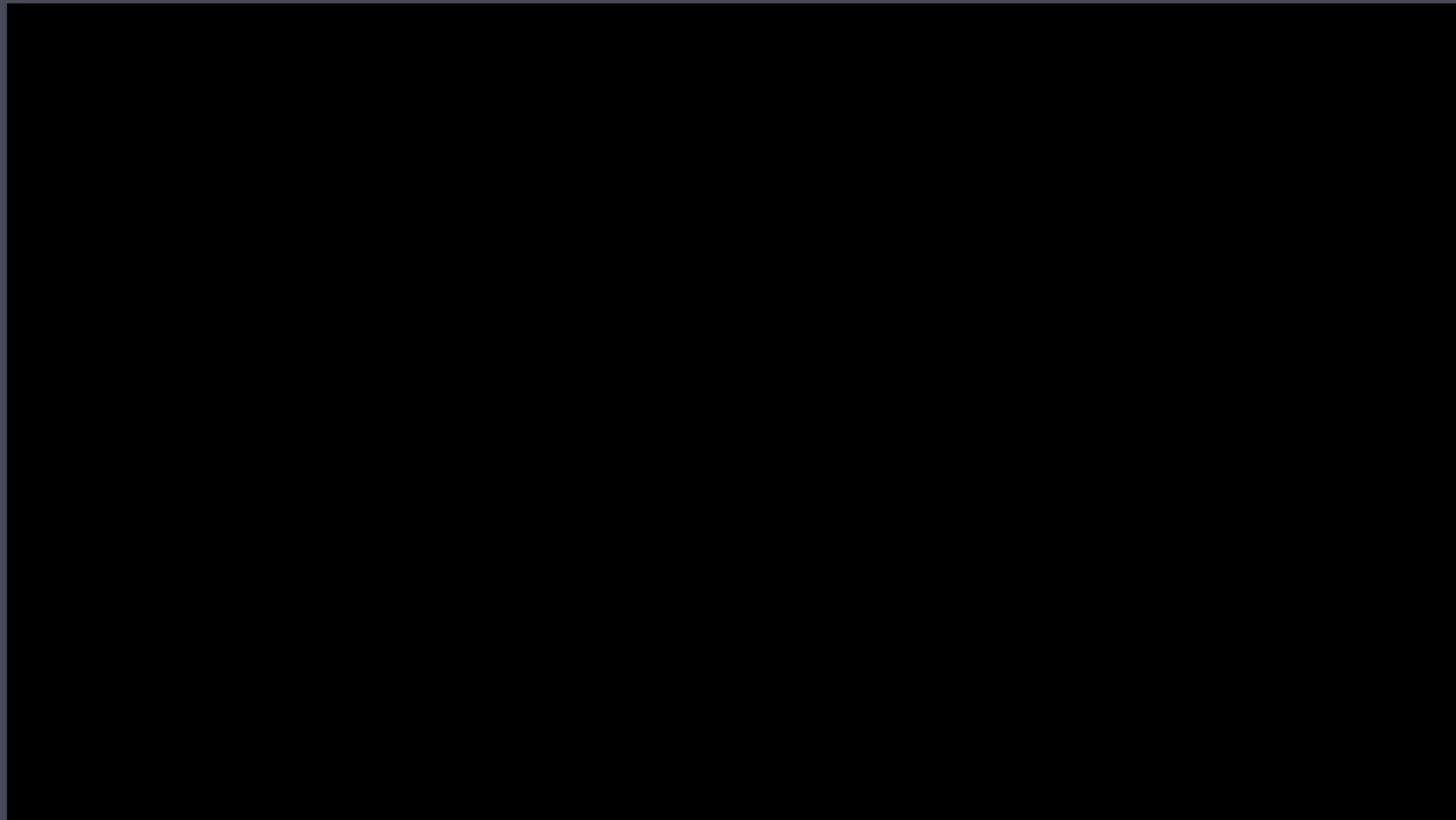
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- Quantitative thinking (not necessarily calculus) is my target (even though calculus is the vehicle).

The main characters



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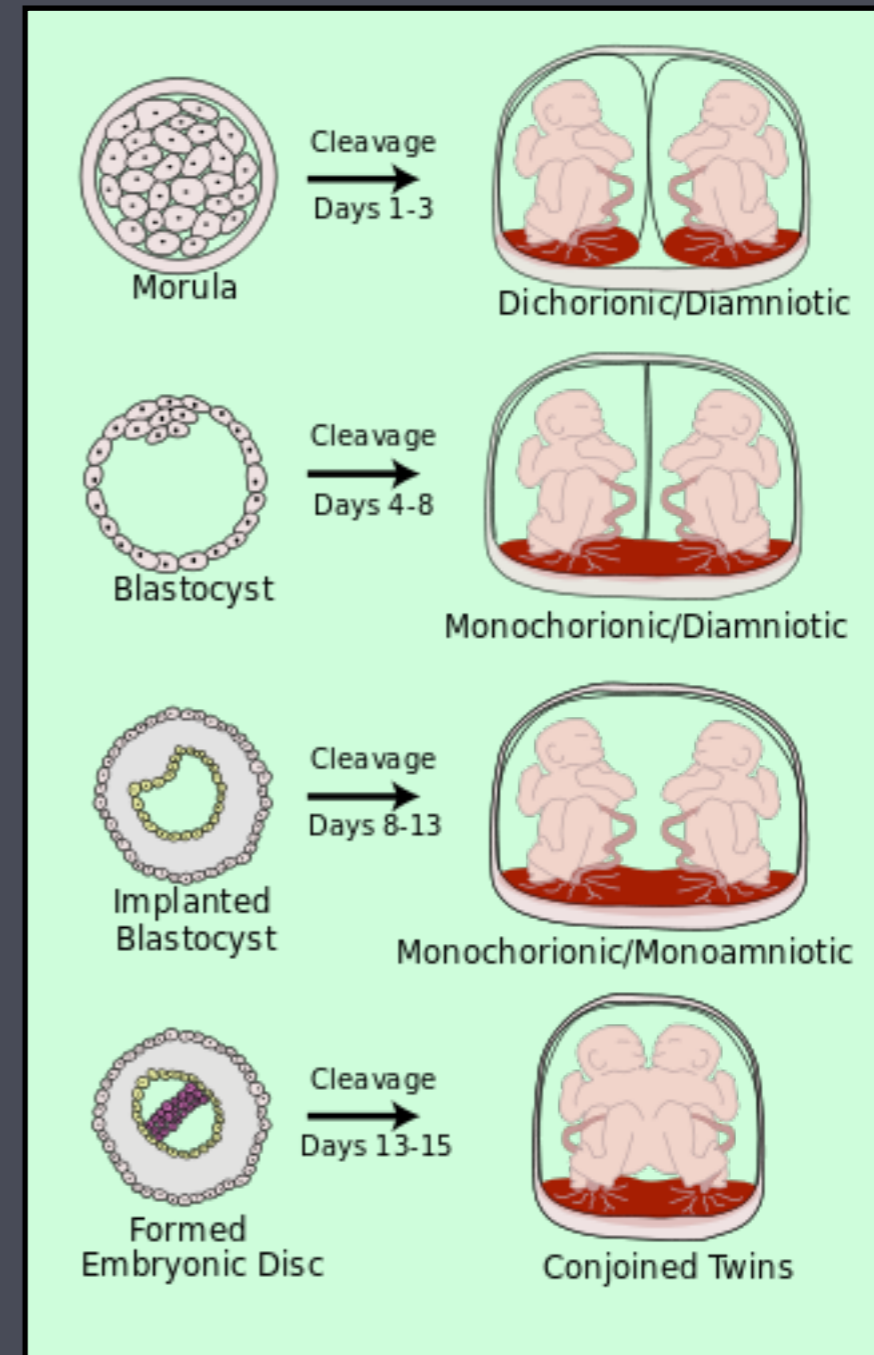
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 - 34 weeks is almost the same as full term.

Monochorionic/ Monoamniotic twins



- ~1 in 50,000 pregnancies
- 1% of twins
- ~8/yr in Canada



Complications

- Cord entanglement
- Cord compression
- Twin-to-twin transfusion syndrome

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- Survival goes up to 81-95% with monitoring.
- Monitoring involves twice-daily ultrasounds, listening to heart beats for irregularities.
- Delivery is by scheduled c-section at 32-34 weeks or earlier by emergency c-section if monitoring reveals problems.

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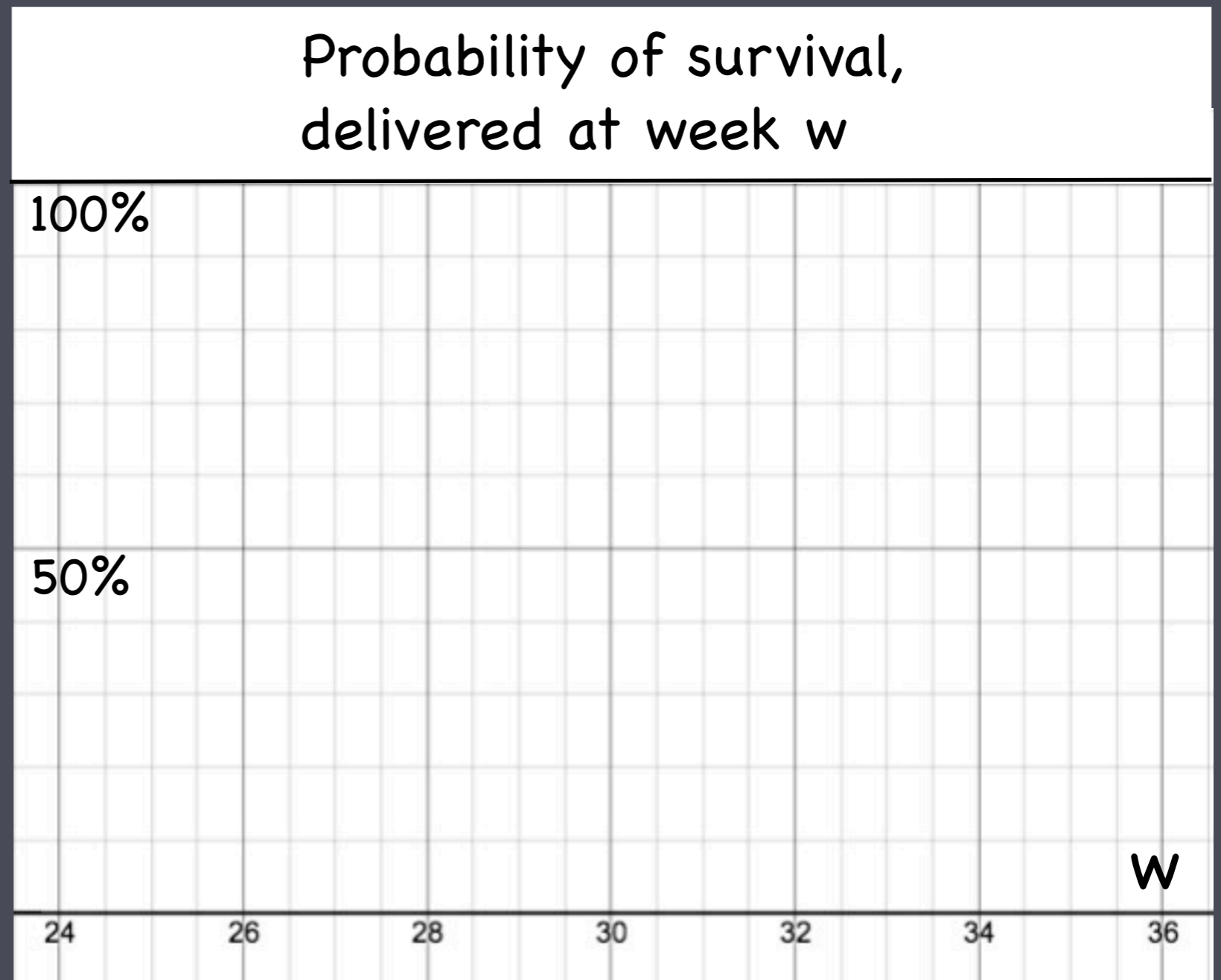
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- Schedule it too late, risk of mono-mono complications goes up.
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- Consider a simple scenario for which analysis is possible (by MATH 102 students)
 - Without monitoring, when should you schedule a c-section?

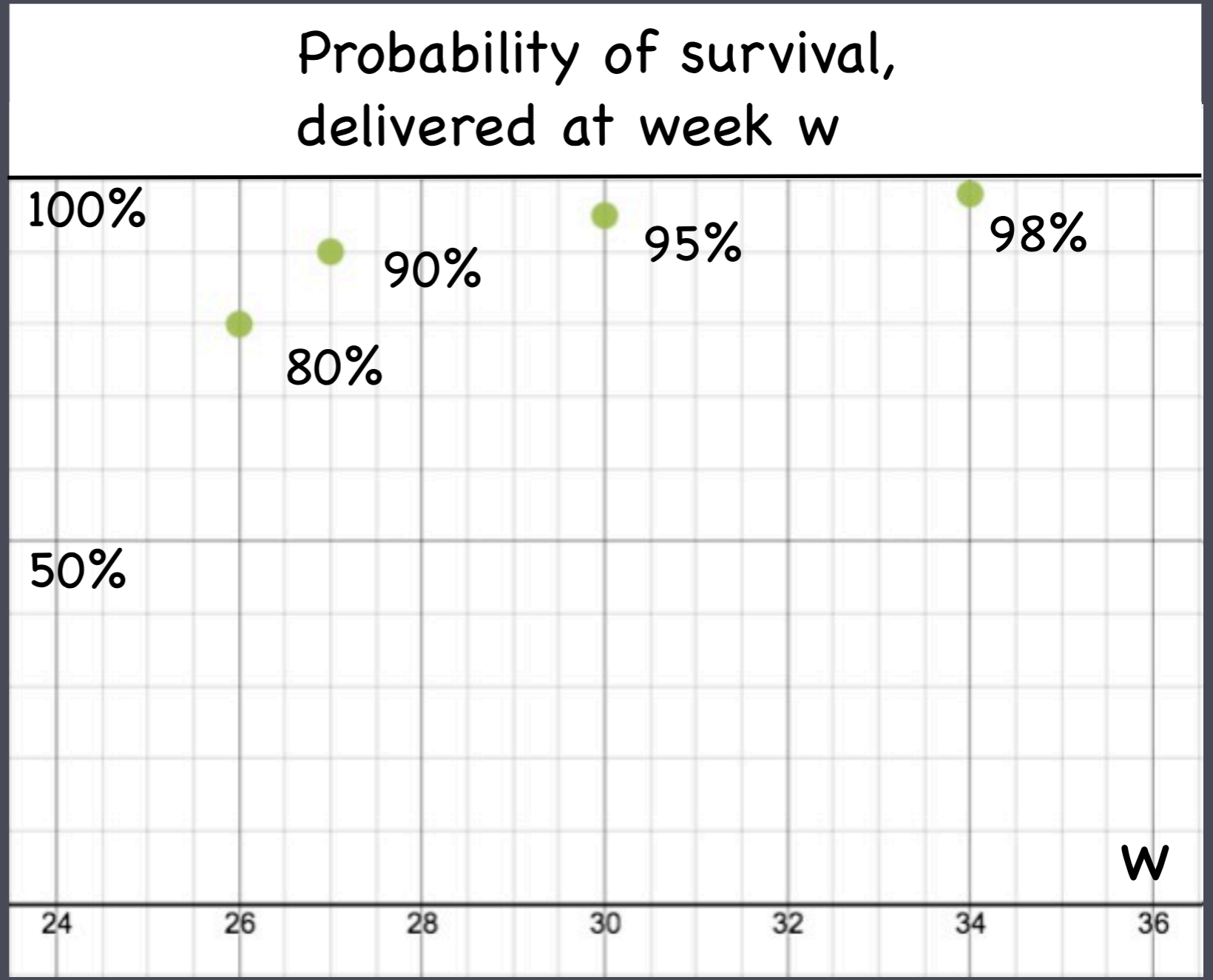
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- Collect premie survival data.
- Fit a smooth curve (Hill function).



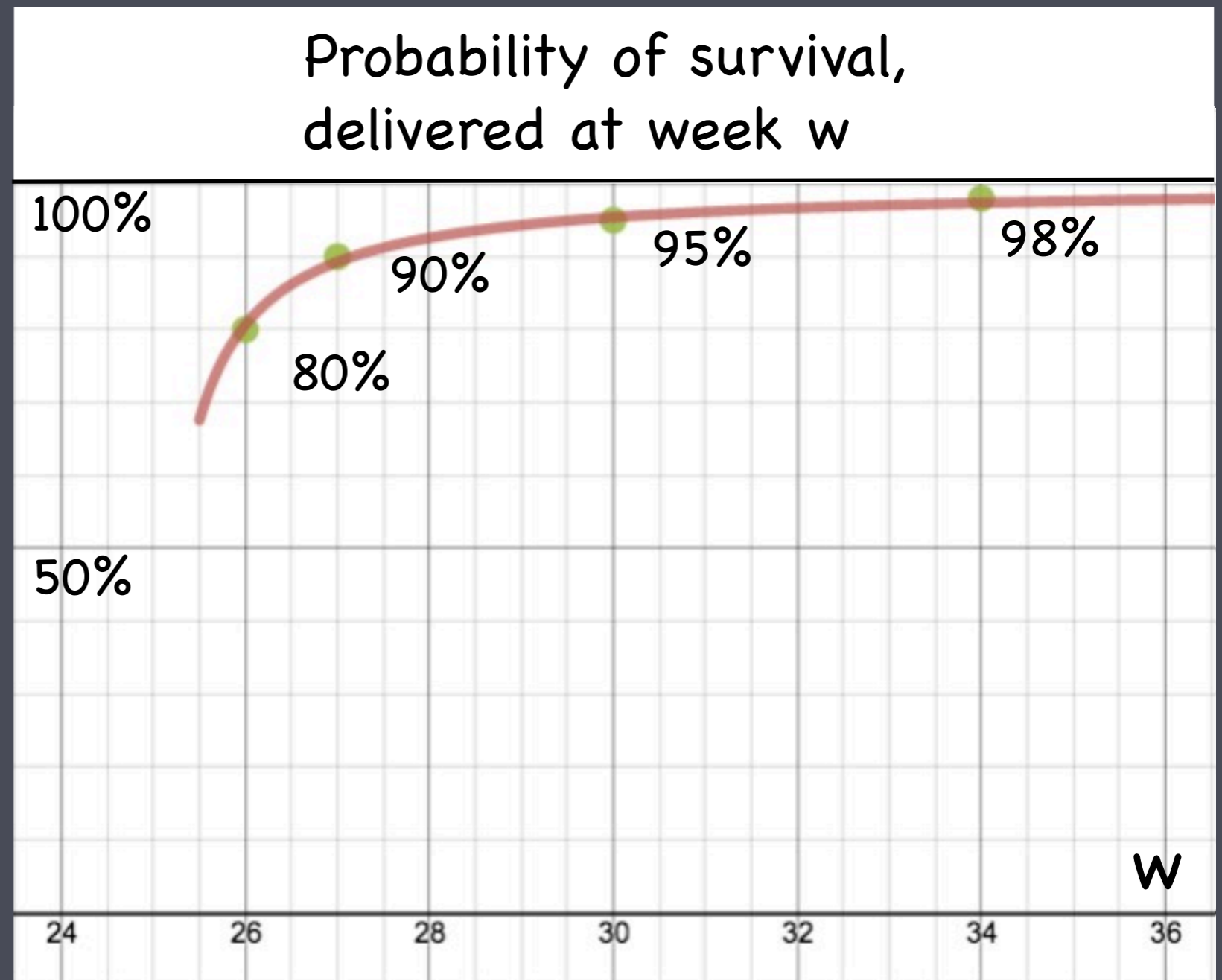
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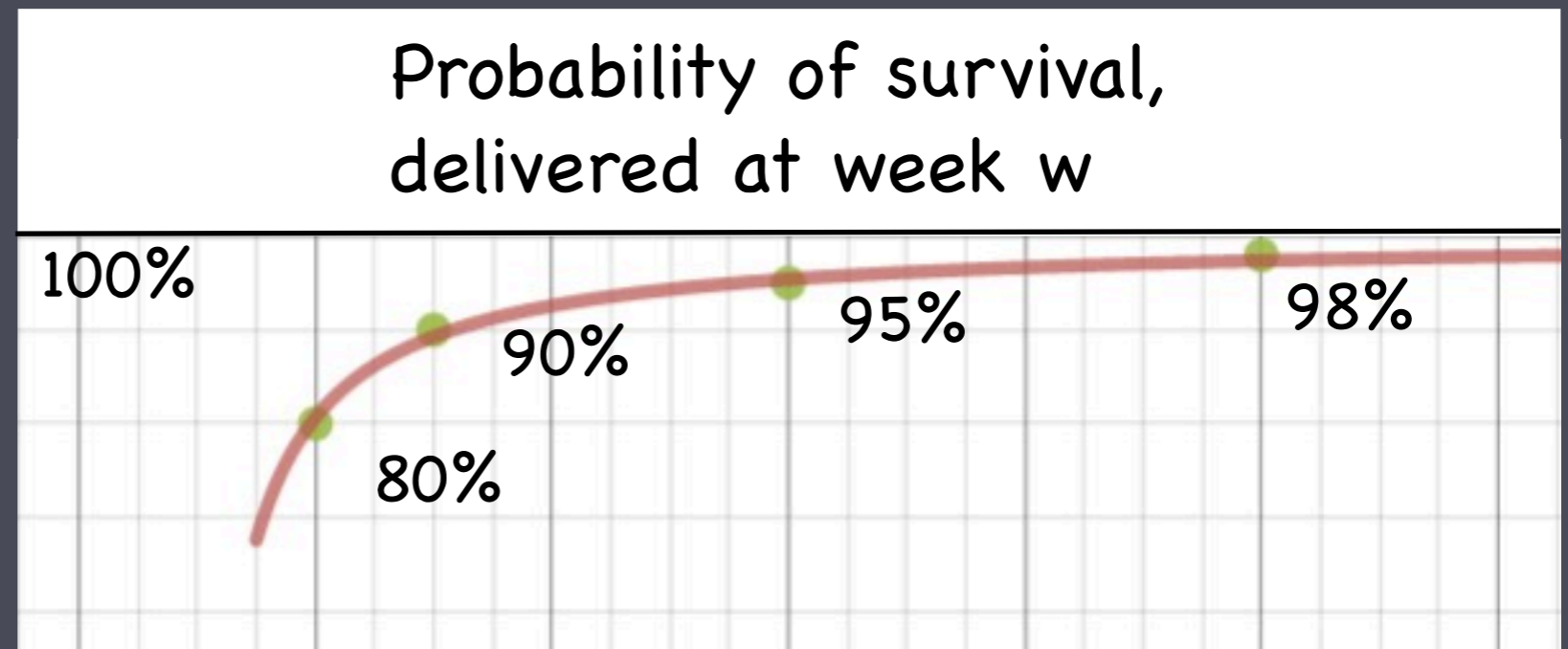
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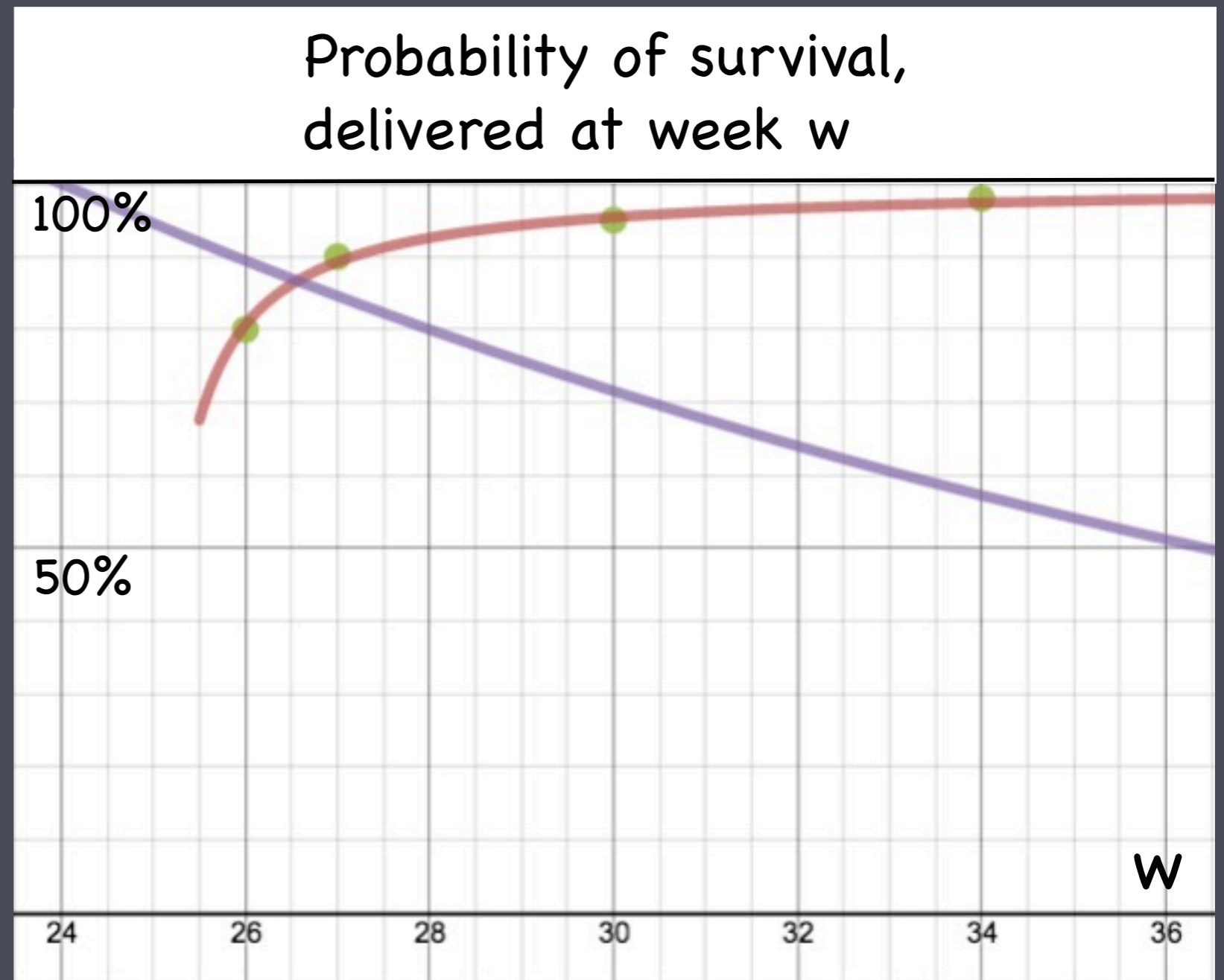


Long Answer Problems

5. During pregnancy, a fraction of twins are at risk of death due to entanglement of their umbilical cords. To prevent such deaths, the twins are removed early by surgery (Caesarean section). However, removing them earlier puts them at risk of death due to premature birth. In this problem, you will determine when to schedule delivery so as to maximize their chance of survival in the face of these opposing risk factors.
- (a) [5 pt] Out of 25 such pregnancies that were identified at 24 weeks into the pregnancy, 16 were still alive at 32 weeks. Write down an exponential function that describes the number of surviving twins, $T(t)$, as a function of the time (measured in weeks) into the pregnancy.

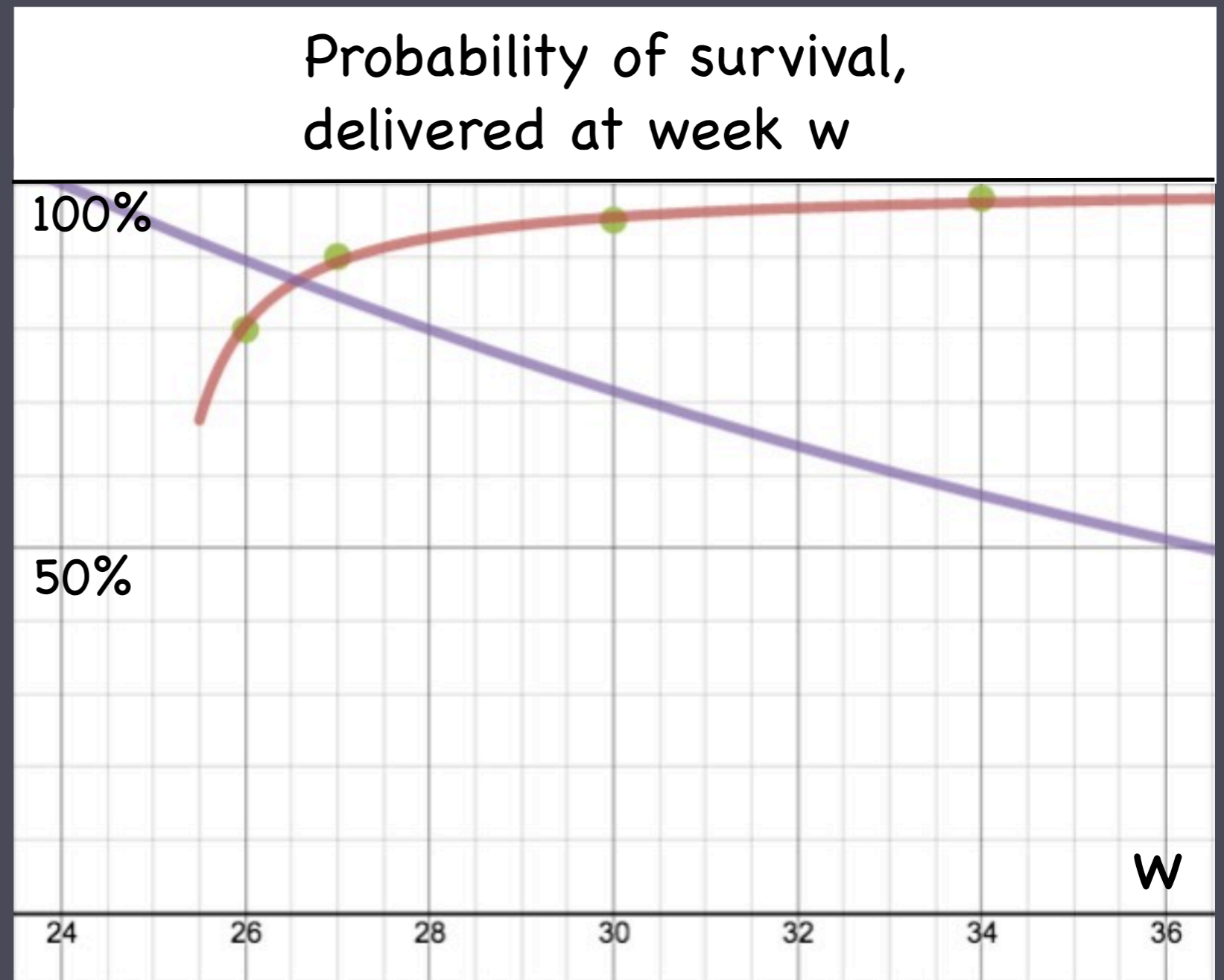
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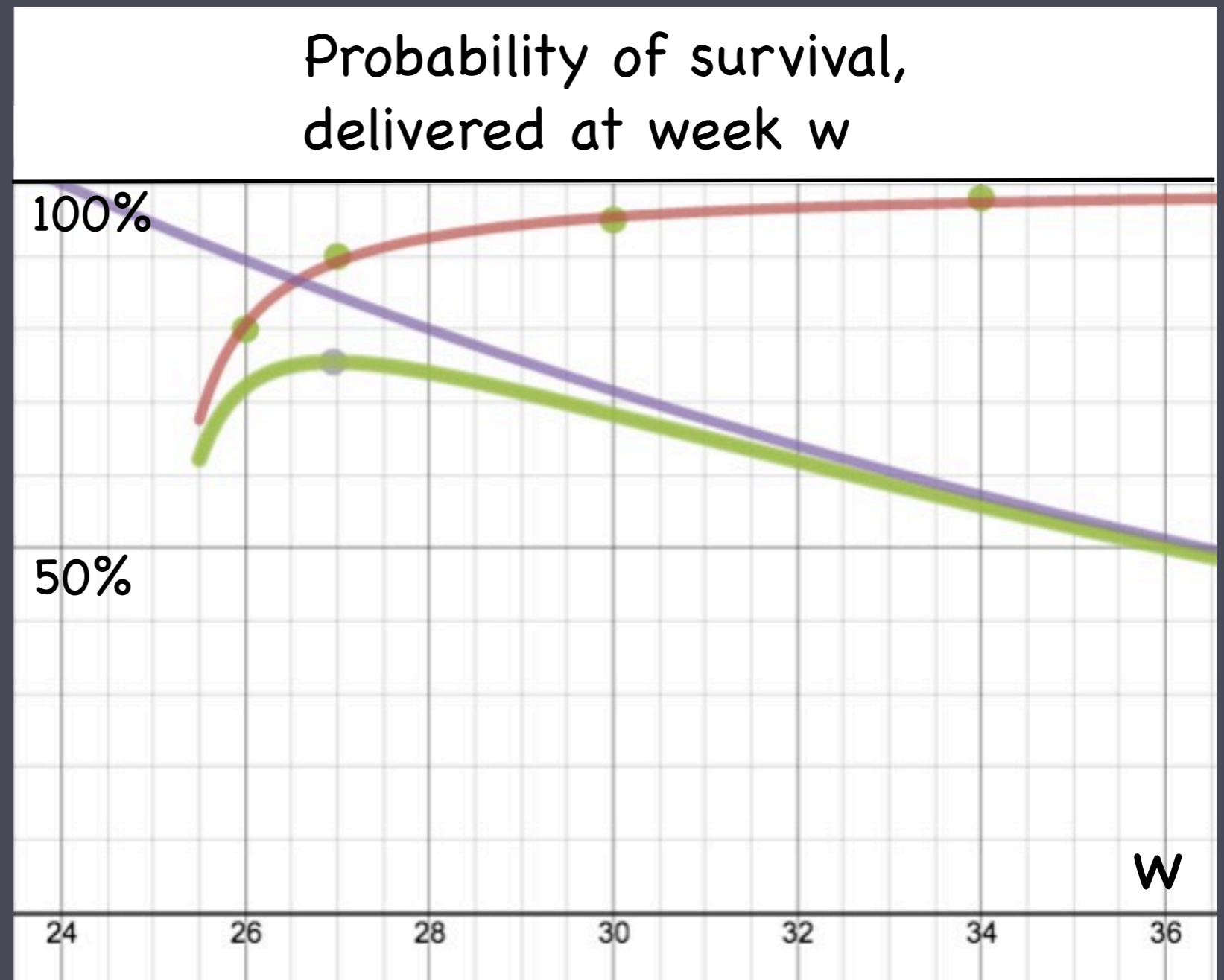
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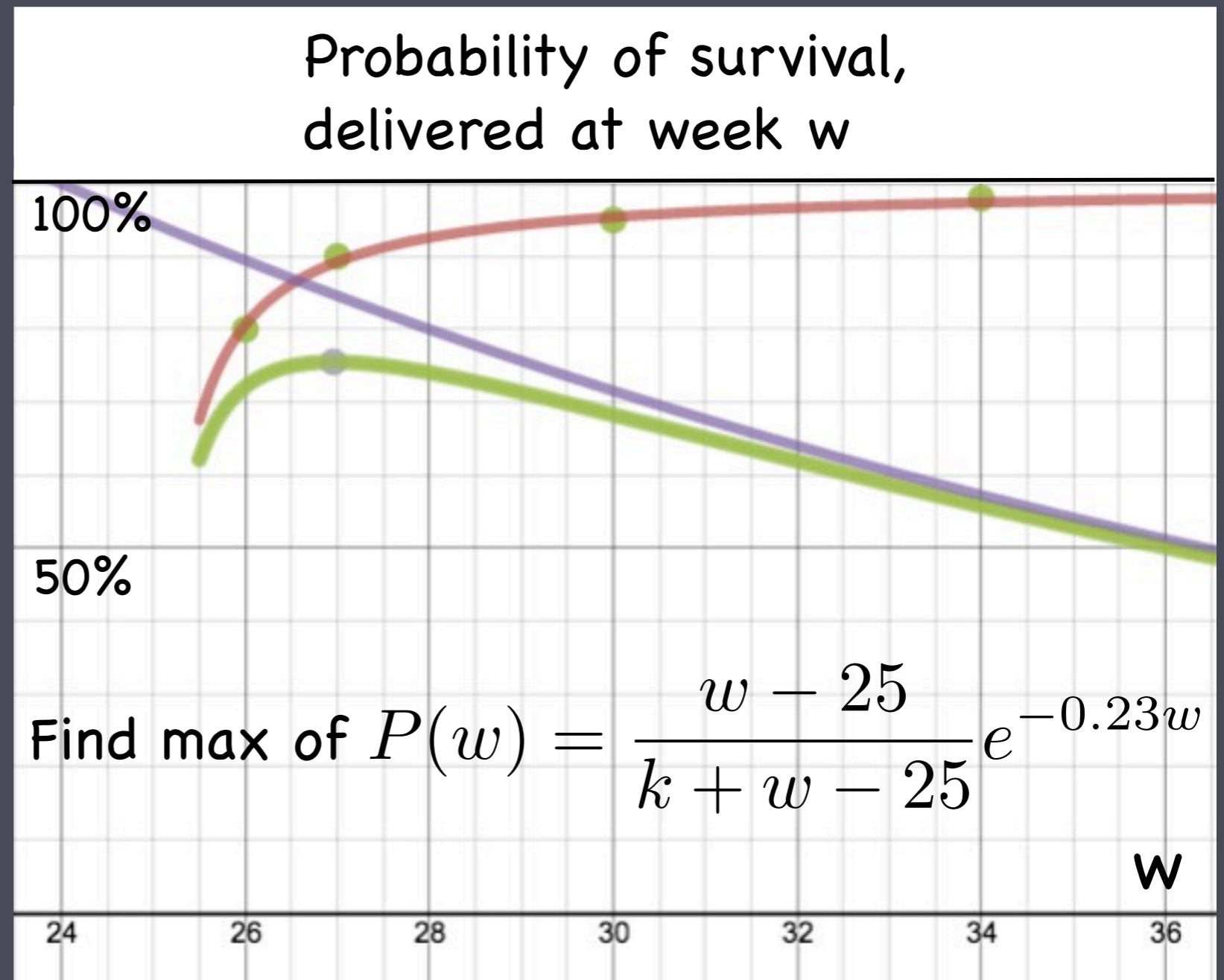
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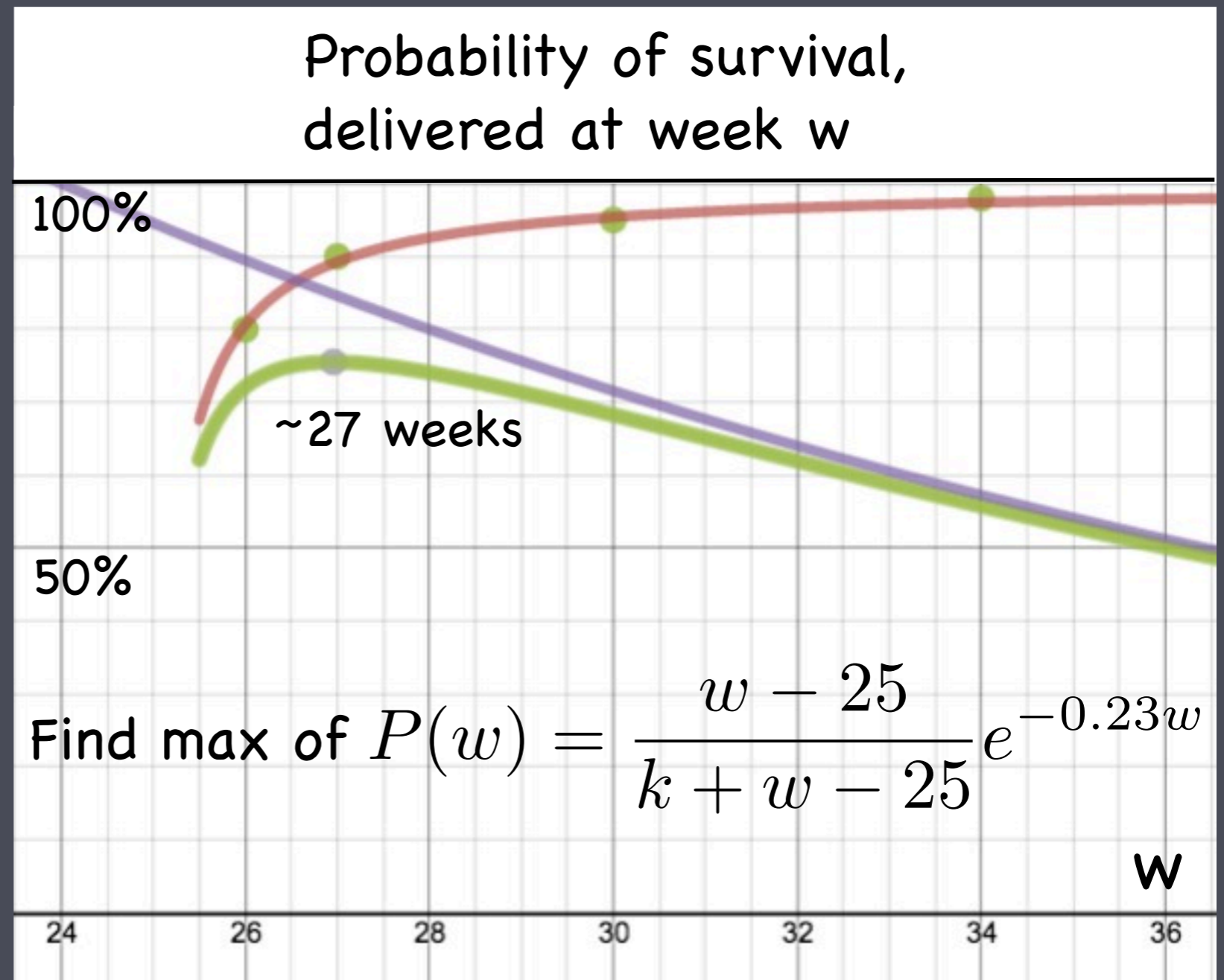
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The more complicated model - with monitoring

- The question: when to start monitoring, when to schedule a (no-later-than) c-section.
- Must account for
 - emergency c-section at any time during monitoring,
 - false alerts, missed events.
- Requires integration and much more data.