## **Alcan Highway Problem**

16 June 2022

Jim Stevenson



This work problem from Geoffrey Mott-Smith ([1]) is a little bit tricky.

An engineer working on the Alcan Highway was heard to say, "At the time I said I could finish this section in a week, I expected to get two more bulldozers for the job. If they had left me what machines I had, I'd have been only a day behind schedule. As it is, they've taken away all my machines but one, and I'll be weeks behind schedule!"

How many weeks?

## **My Solution**

Recall the model for such problems from the post "Fibonacci, Chickens, and Proportions".<sup>1</sup>

s = number of highway sections built	d = number of days working
b = number of bulldozers	r = rate of highway construction per bulldozer per day
Model:	s = r b d

We first wish to solve for the constant rate r of building the highway. We still have one more unknown, namely, the actual number of bulldozers in hand x. One stretch of highway can be built in 1 week or 7 days with x + 2 bulldozers. Therefore,

$$1 = \mathbf{r} \cdot (\mathbf{x} + 2) \cdot \mathbf{7}.$$

And 1 stretch of highway can be built in 8 days with the current number of bulldozers x. Therefore,

 $1 = \mathbf{r} \cdot \mathbf{x} \cdot \mathbf{8}.$ 

Combining these two equations and eliminating x gives the rate

 $r = 1/(7 \cdot 16)$  stretches of highway per bulldozer per day.

Therefore, the engineer can build 1 stretch of highway with 1 bulldozer in d days, where

 $1 = r \cdot 1 \cdot d = d/(7 \cdot 16) \implies d = 7 \cdot 16 \text{ days} = 16 \text{ weeks}$ 

Which means he will be 15 weeks behind schedule.

## **Mott-Smith Solution**

His solution is really just the answer.

Fifteen weeks behind schedule. That is, the whole job will take one bulldozer sixteen weeks.

## References

[1] Mott-Smith, Geoffrey, "#70 The Alcan Highway", *Mathematical Puzzles for Beginners & Enthusiasts*, Blakiston Co, 1946, 2<sup>nd</sup> revised edition, Dover Publications, 1954. p.36.

© 2022 James Stevenson

<sup>&</sup>lt;sup>1</sup> http://josmfs.net/2019/09/06/fibonacci-chickens-and-proportions/