

## Reply by Author to D. J. Zigrang

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**C**OMMENTS by Zigrang<sup>1</sup> on my recent engineering note<sup>2</sup> suggested that Eq. (2) of that note, representing expected launch payload losses, is better described by the expression

$$\text{losses} = npw_p \quad (1)$$

I appreciate the opportunity of noting an inadvertent tran-

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scription omission in Eq. (2) which should contain the factor  $n$  and read

$$\text{losses} = npw_p[(1 - p^n)/(1 - p)] \quad (2)$$

Actually, when considering many launchings, Eq. (2) reduces to  $npw_p/(1 - p)$ , and, if small values of  $p$  are the situation, then a further approximation leads to the expression  $npw_p$ , which is identical to Eq. (1).

The fundamental difference between Eqs. (1) and (2) is most simply explained by the fact that Eq. (1) does not consider the losses of the replaced payloads and, therefore, will always be less in value than Eq. (2) by approximately the factor  $(1 - p)$ .

### References

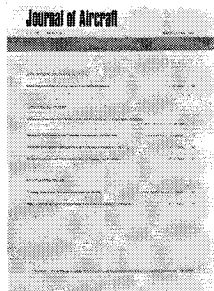
<sup>1</sup> Zigrang, D. J., "Comment on cost minimization of a space system by multiple launchings," J. Spacecraft Rockets 1, 447 (1964).

<sup>2</sup> Allen, R. W., "Cost minimization of a space system by multiple launchings," J. Spacecraft Rockets 1, 112-113 (1964).

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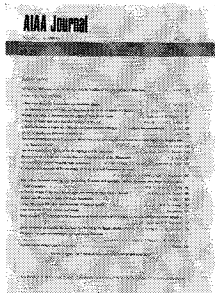
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