SPINOFFS

Spinoffs are relatively short learning modules inspired by the LTAs. They can be easily implemented to support student learning in courses ranging from prealgebra through calculus. The Spinoffs typically give students an opportunity to use mathematics in a real world context.

LTA - SPINOFF 1A — How a Change in the Number of Flights Per Year Affects the Probability of Sufficiency

LTA - SPINOFF 1B — How the Number of Flights Per Year Changes the Total Projected Operating Time

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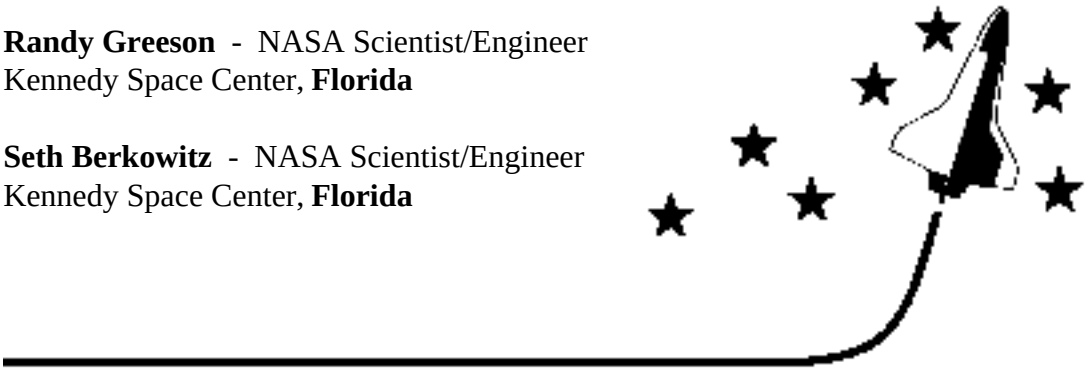

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SPINOFF 1A

How a Change in the Number of Flights per Year Affects the Probability of Sufficiency for Fuel Cells

The number of spares needed depends on the number of flights scheduled during the year. As of May 1997, the Probability of Sufficiency (POS) calculations are based on 8 flights per year, but this number could increase.

In LTA 1, you carried out a sequence of steps to calculate the POS for fuel cells assuming that the Shuttle is scheduled for 8 flights per year. Follow the same steps and complete Table 1 below to find the Total Projected Operating Time (TPOT) and lambda (λ) for 12 flights per year and for 15 flights per year.

1)

Table 1

Flights per Year	Total Projected Operating Time (TPOT)	Lambda (λ)
8		
12		
15		

Assume that T, the repair turnaround time, is 316 days. How many spares are needed to have a Probability of Sufficiency (POS) of 90% for 8, 12, and 15 flights per year. Answer this question in two different ways: numerically (Exercise 2) and graphically (Exercise 3).

2. a) Determine how many spares are needed by filling in Table 2 below, until a POS of 90% is reached.

Recall that

$$\text{POS} = \sum_{n=0}^{S} P(n) = \sum_{n=0}^{S} \frac{(\lambda T)^n * e^{-\lambda T}}{n!}$$

Table 2

S (Total Spares)	0	1	2	3	4												
POS (8 flights per year)																	
POS (12 flights per year)																	
POS (15 flights per year)																	

b) The number of spares necessary for a POS of 90% for
   - 8 flights per year is _____
   - 12 flights per year is _____
   - 15 flights per year is _____

c) Suppose that the engineers at NASA are willing to accept a POS of 75%. That is, _____ times out of _____ a spare unit will be available when needed.

d) The number of spares necessary for a POS of 75% for
   - 8 flights per year is _____
   - 12 flights per year is _____
   - 15 flights per year is _____

e) Under what conditions might an engineer be willing to accept a POS of 75% instead of 90%?

3) For each of the flight rates, 8, 12, and 15, sketch the graph showing Probability of Sufficiency vs. number of spares. Explain how you can use these graphs to determine the number of spares needed to reach a 90% POS. Now apply this process to find the number of spares for each of the flight rates to reach:
   a) 90% POS.
   b) 75% POS.

   Hint:
   Refer to Section 1 Part D of the LTA, **Calculating the Probability of Sufficiency Using the TI-83™ Graphing Calculator.** Section 1 Part D describes the steps for producing the graph when the flight rate is 8.

4) Compare your results obtained from the graphs with the results you calculated in Exercise 1 using the formula.