Counting dinner combinations

Exercise example

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Counting exercise

Exercise

A dinner meal ought to comprise both starch and protein. Suppose you have the options of potatoes, rice, and spaghetti for the starch and beef, chicken, or meatballs for the protein.
How many different dinners can you cook? Assume that you are allowed only one ingredient of each type.

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Formalising

Step 1

$A = \{\text{meatballs}, \text{beef}, \text{chicken}\} = \{m, b, c\}$

$B = \{\text{spaghetti}, \text{potato}, \text{rice}\} = \{s, p, r\}$

$D = \{(x, y) : x \in A, y \in B\}$ $(= A \times B)$

Partitioning

Step 2a

$$D = \bigcup_{x \in A} D_x = D_b \cup D_c \cup D_m .$$

where D_x is the set of dinners including x, with $x \in A$.

$$D_{x_1} \cap D_{x_2} = \emptyset \quad \text{if} \quad x_1 \neq x_2$$

Counting

Step 3a

D_x involves fixing x, and choosing freely a $y \in B$, to form $(x\,y)$

$|D_x| = |B| = 3$ for any $x \in A$

Product principle applies:

$B = \bigcup_{x \in A} D_x \Rightarrow |B| = |D_x| \cdot |A|$

$= 3 \cdot 3 = \underline{\underline{9}}$

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Concluding

Step 4

Product principle gives

$$|D| = |B| \cdot |A|$$

$$= 3 \cdot 3 = \underline{\underline{9}}$$