CS4515 Homework 1: Problem 1.2

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(a) How much profit do you make on each wafer of Phoenix chips?

$$\frac{\text{dies}}{\text{wafer}} = \frac{\pi \times \left(\frac{\text{wafer diameter}}{2}\right)^2}{\text{die area}} - \frac{\pi \times \text{wafer diameter}}{\sqrt{2 \times \text{die area}}}$$

$$= \frac{\pi \times \left(\frac{450\text{ mm}}{2}\right)^2}{200\text{ mm}^2} - \frac{\pi \times 450\text{mm}}{\sqrt{2 \times 200\text{mm}^2}} = 795 - 71 = 724 \text{ dies/wafer}$$

$$\text{die yield} = \text{wafer yield} \times \frac{1}{(1 + \text{defects per unit area} \times \text{die area})^N}$$

$$= 724 \times \frac{1}{(1 + 0.0004/\text{mm}^2 \times 200\text{mm}^2)^{14}} = 724 \times \frac{1}{(1.08)^{14}} = 246 \text{ dies}$$

$$\text{profit} = \text{die yield} \times \text{profit/die} = 246 \times \$30 = \$7380$$

(a) Each wafer makes a profit of $7380

(b) How much profit do you make on each wafer of RedDragon chips?

$$\frac{\text{dies}}{\text{wafer}} = \frac{\pi \times \left(\frac{450\text{ mm}}{2}\right)^2}{120\text{mm}^2} - \frac{\pi \times 450\text{mm}}{\sqrt{2 \times 120\text{mm}^2}} = 1325 - 91 = 1234 \text{ dies/wafer}$$

$$\text{die yield} = 1234 \times \frac{1}{(1 + 0.0004/\text{mm}^2 \times 180\text{mm}^2)^{12}} = \frac{1234}{(1.072)^{12}} = 640 \text{ dies}$$

$$\text{profit} = 640 \times \$15 = \$9600$$

(b) Each wafer makes a profit of $9600

(c) Demand: 50,000 Red Dragon chips, 25,000 Phoenix chips Constraint: 70 wafers/month

$$\frac{50{,}000 \text{ red dragon wafers}}{656 \text{ chips/wafer}} = 76.22 \text{ wafers} \qquad \frac{25{,}000 \text{ phoenix wafers}}{246 \text{ chips/wafer}} = 101.6 \text{ wafers}$$

(c,1) To maximize profit, you should only make RedDragon wafers
$70 \times \$9600 = \$672{,}000$ profit

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Alternatively, perhaps you want to meet the same amount of demand for each.

x = proportion of demand met

$$\frac{x * 50{,}000 \text{ reddragon}}{656 \text{ chips/wafer}} + \frac{x * 25{,}000 \text{ Phoenix}}{246 \text{ chips/wafer}} = 70 \text{ wafers}$$

$$x * 50{,}000 * \frac{246}{656} + x * 25{,}000 * 656 = 70 * 246 * 656$$

$$12{,}300{,}000x + 16{,}400{,}000x = 11{,}296{,}320$$

$$x = 0.3936$$

$$0.3936 * \frac{50{,}000 \text{ red dragon}}{656 \text{ chips/wafer}} = 30 \text{ wafers}$$

$$0.3936 * \frac{25{,}000 \text{ Phoenix}}{246 \text{ chips/wafer}} = 40 \text{ wafers}$$

C,2 Assuming you want to meet the same proportion of the demand for each (39.36% demand met), you should make 30 RedDragon wafers and 40 Phoenix wafers