



The graph above, based upon research by the National Sea Ice Data Center (Courtesy Steve Deyo, UCAR), shows the amount of Arctic sea ice in September (coldest Arctic month) for the years 1950-2006, based on satellite data (since 1979) and a variety of direct submarine measurements (1950 - 1978). The blue region indicates model forecasts based on climate models. Meanwhile, the figure on the right shows the results of polls conducted between 2006 and 2009 of 1,500 adults by the Pew Research Center for the People & the Press. The graph indicates the number of people, in all three major political parties, believing there is strong scientific evidence that the Earth has gotten warmer over the past few decades.

**Problem 1** - Based on the red curve in the sea ice graph, which gives the number of millions of square kilometers of Arctic sea ice identified between 1950 and 2006, what is a linear equation that models the average trend in the data between 1950-2006?

**Problem 2** - Based on the polling data, what are the three linear equations that model the percentage of Democrats (Dem.), Independents (Ind.) and Republicans (Rep.) who believed that strong evidence existed for global warming?

**Problem 3** - From your linear model for Arctic ice cover, about what year will the Arctic Ice Cap have lost half the sea ice that it had in 1950-1975?

**Problem 4** - From your model for the polling data, by about what years will the average American in the Pew Survey, who identifies themselves as Democrats, Independents or Republicans, no longer believe that there is any scientific evidence at all for global warming?

**Problem 1** - Based on the red curve in the graph, which gives the number of millions of square kilometers of Arctic sea ice identified between 1950 and 2006, what is a linear equation that models the average trend in the data between 1950-2006? Answer: The linear equation will be of the form  $y = mx + b$ . From the graph, the y-intercept for the actual data is 8.5 million  $\text{km}^2$  for 1950. The value for 2006 is 5.5 million  $\text{km}^2$ . The slope is  $m = (5.5 - 8.5) / (2006 - 1950) = -0.053$ , so the equation is given by  **$Y = -0.053(x-1950) + 8.5$**  in millions of  $\text{km}^2$ .

**Problem 2** - Based on the polling data, what are the three linear equations that model the percentage of Democrats (Dem.), Independents (Ind.) and Republicans (Rep.) who believed that strong evidence existed for global warming?

Answer:

**Dems:**  $m = (75\% - 90\%)/(2009-2006) = -5.0$ , so the model becomes

$$y = -5.0(x - 2006) + 90 \text{ percent ;}$$

**Ind.**  $m = (52\% - 79\%)/(2009-2006) = -9.0$ , so the model becomes

$$y = -9.0(x - 2006) + 79 \text{ percent.}$$

**Rep. ;**  $(35\% - 60\%)/(2009-2006) = -8.3$ , so the model becomes

$$y = -8.3(x - 2006) + 60 \text{ percent}$$

**Problem 3** - From your linear model for Arctic ice cover, about what year will the Arctic Ice Cap have lost half the sea ice that it had in 1950-1975?

Answer: In 1950-1975 there were about 8.5 million  $\text{km}^2$  of sea ice in September. Half of this is 4.3 million  $\text{km}^2$ . Set  $y = 4.3$  and solve for  $x$ :

Solve  $4.3 = -0.053(x-1950) + 8.5$  to get

$$-4.2 = -0.053(x-1950)$$

$$4.2 = 0.053(x-1950)$$

$$4.2/0.053 = x-1950$$

$$79 = x - 1950$$

And so  $x = 2029$ . So, during the year **2029 AD** there will only be half as much sea ice in the Arctic in September.

**Note:** If we use only the slope data since 1975 when the ice cover was 8.0 million  $\text{km}^2$ , the slope would be  $m = (5.5 - 8.0)/(2006-1975) = -0.083$ , and linear equation is  $y = -0.083(x-1975) + 8.0$ . The year when half the ice is present would then be about 2023 AD, because the slope is steeper during the most recent 30 years. If the slope continues to steepen with time, the year when only half the ice is present will move closer to the current year.

**Problem 4** - From your model for the polling data, by about what years will the Democrats, Independents and Republicans no longer believe that there is any scientific evidence at all for global warming?

Answer: Solve each linear model in Problem 2 for  $X$ , given that  $y=0$ :

Democrats:  $0 = -5.0(x - 2006) + 90$  so  $x =$  **2024 AD.**

Independents:  $0 = -9.0(x-2006) + 79$  so  $x =$  **2015 AD**

Republicans:  $0 = -8.3(x-2006) + 60$  so  $x =$  **2013 AD.**