

The **ScienceMath**-project: **GPS spies and fair insurance premiums**
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Teaching Material

Work sheets and tasks (see next pages)

GPS spies and fair insurance premiums

What is a fair insurance premium?

Have you considered buying a car in the near future? That could be an expensive affair with respect to car insurance. Up until now most insurance companies have had only national statistics at their disposal when determining the yearly insurance premium (the amount the consumer has to pay, in order for his or her car to be insured). And these statistics are not promising: For 18-19 years olds the risk of being involved in a serious accident is 7 times as high as that of your parents. If you are between 20 and 24 years old, the risk is 3 times as high as that of your parents. And surely, if the risk that you will be involved in an accident is increased, there is an increased risk that you will make insurance claims to your insurance company.

But is this a fair way to determine the yearly premium? What about those young people who actually are good drivers? And what about those 40 year olds who drive recklessly? Even many insurance companies agree that this way of calculating the yearly premium is not fair. And some have started to use innovative technology instead of just national statistics.

In table 1 you will find some data on ten drivers including their individual yearly premiums.

Assignment 1: Can you find a pattern in Table 1? Which mathematical tools (graphs, table, equations etc.) did you use to identify a pattern, and why did you use these tools? Which three factors (i.e. which columns) seem to have a decisive effect on the insurance premium? Why do you think that these factors seem to be important? Give an estimate of the relative weight of these factors.

The insurance company *Pay As You Drive*, for one wanted to be fair towards their costumers. And the director has asked himself, "what if the premium is determined by how you *actually* drive, and not by how people with their characteristics drive in general?" In a test period of one month, *Pay As You Drive* asked the ten costumers mentioned above to install a GPS spy device in their car. This device is, on the one hand, a normal GPS navigation device which can capture location and speed data of a car. On the other hand, the device is connected to network through a 3G broadband modem, and the device is able to transmit data to a server at *Pay As You Drive's* analysis office.

Watch it here: You can read an article and watch a video from abc-News about GPS guided insurance here: <http://abcnews.go.com/GMA/Travel/story?id=5392695&page=1>

In Tables 2 and 3 you find some of the data captured by the GPS spy device.

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Person	Age	Years with driver's license	Years with own car	Type of car	Car produced in...	Number of claims in the last 3 years	Miles driven per day	Yearly premium (in €)
Andrew	59	41	41	Large	1999	1	203	730
Beth	26	1	1	Small	1998	0	50	2068
Christina	42	23	12	Medium	1987	3	124	2000
Dennis	19	1	1	Fast	1984	0	88	2619
Elaine	30	12	7	Medium	2007	0	10	784
Frank	32	14	11	Large	2001	1	388	1176
George	78	60	60	Small	1992	0	9	608
Hillary	19	1	1	Small	2000	1	29	2500
Ian	23	5	5	Small	1998	2	153	2654
Jeremiah	27	2	1	Fast	2004	0	98	1135

Table 1 - General information.

Person	Driving in urban areas (max. 40 mph)		Driving on highway (max. 80 mph)		Driving on freeway (max. 100 mph)		Miles driven on very dangerous roads	Miles driven on dangerous roads	Miles driven on less dangerous roads
	miles	Top speed	miles	Top speed	miles	Top speed			
Andrew	50	39 mph	136	89 mph	17	112 mph	20	93	110
Beth	2	38 mph	48	76 mph	-	-	48	-	2
Christina	70	43 mph	12	84 mph	42	103 mph	-	12	112
Dennis	-	-	88	112 mph	-	-	68	20	-
Elaine	10	32 mph	-	-	-	-	-	-	10
Frank	70	54 mph	68	90 mph	250	110 mph	89	130	169
George	9	24 mph	-	-	-	-	-	-	9
Hillary	4	39 mph	25	89 mph	-	-	12	12	5
Ian	-	-	153	98 mph	-	-	60	73	20
Jeremiah	12	44 mph	12	97 mph	74	115 mph	16	30	52

Table 2 - Driving habits as revealed by the GPS spy-device.

Person		Drives primarily...
Andrew	<ul style="list-style-type: none"> - Parks 8 hours on a private company parking lot. - Drives two times a day through three dangerous intersections in each of which on average 18 serious accidents happen each year. 	during rush hours
Beth	<ul style="list-style-type: none"> - Drives on a very dangerous rural highway where he has to overtake a number of agricultural machines. 	during off-peak hours
Christina	<ul style="list-style-type: none"> - Parks 9 hours on a public parking lot with room for 2000 cars where on average 1 minor accident takes place per day and where on average 5 cars are stolen each year. 	during rush hours
Dennis	<ul style="list-style-type: none"> - Drives on a very dangerous rural highway where he has to overtake a number of agricultural machines. 	during off-peak hours
Elaine	<ul style="list-style-type: none"> - Parks 8 hours on a private company parking lot. - Turns right at three intersections where there is an increased risk of right-turn accidents involving bicycle riders. 	during rush hours
Frank	<ul style="list-style-type: none"> - Drives on a stretch of freeway where a lot of solo accidents happen. - Drives on a very dangerous rural highway where he has to overtake a number of agricultural machines. - Drives two times a day through eight dangerous intersections in which on average 5 to 7 serious accidents happen each year. - Parks 8 hours on a private company parking lot. 	during rush hours
George		during off-peak hours
Hillary	<ul style="list-style-type: none"> - Drives on a very dangerous rural highway where he has to overtake a number of agricultural machines. 	during rush hours
Ian	<ul style="list-style-type: none"> - Drives on a very dangerous rural highway where he has to overtake a number of agricultural machines. - Drives two times a day through four dangerous intersections in which on average 9 to 11 serious accidents happen each year. 	during off-peak hours
Jeremiah	<ul style="list-style-type: none"> - Drives two times a day through a dangerous intersection in which on average 20 serious accidents happen each year. 	during rush hours

Table 3 – Additional information revealed by the GPS spy-device.

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Assignment 2: As you can see the company has, on before hand, categorized some stretches of road as “very dangerous”, “dangerous” and “less dangerous”. Which factors would you focus on in such a classification? Find your own way to make it easy to classify a given stretch of road on the grounds of data about that road respective to these factors.

Assignment 3: Choose from all the factors found in the three tables those which you would focus on if you were to help *Pay As You Drive* to determine individual premiums for the ten costumers. Why did you choose these factors? And should they have an equal relative weight?

Assignment 4: Construct a model which takes into account the factors you identified in the last assignment. You can use whatever modeling tool you like – i.e. you can draw graphs, make tables, make equations etc. The model should be a tool for determining a fair individual premium for the costumers.

Assignment 5: Discuss benefits and drawbacks of using a GPS spy device. Are there other benefits than determining a fair insurance premium? Is it in fact *more* fair to determine the premium in this way?