

## MODELS OF WEATHER AND TRANSIT DEMAND IN PUBLIC CITY TRANSIT IN PARDUBICE

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Demand in public transit is influenced by wide range of factors, weather is one of them. Citizens of Pardubice make a lot of journeys every day. They can walk, ride their bicycle, motorbike or car, or they can use public transit. Weather is important for their decision-making about their mode of transportation, because when it is frosty, windy or rainy some cyclists leave their bicycle home and prefer cover vehicles, as well as people, who in sunny days prefer walking.

This paper researches the relationship between demand for public transit in Pardubice and weather and it will show the correlation between variables.

**Key words:** public transit demand, weather, correlation

### 1 Weather and transport

Demand for public city transport, thus demand for services of The Pardubice Transport Company, is variable during a year. When summer comes near, the temperature increases, precipitation and wind decreases and the sun shines more, the number of passengers decreases too. This fact is shown on the figure below.

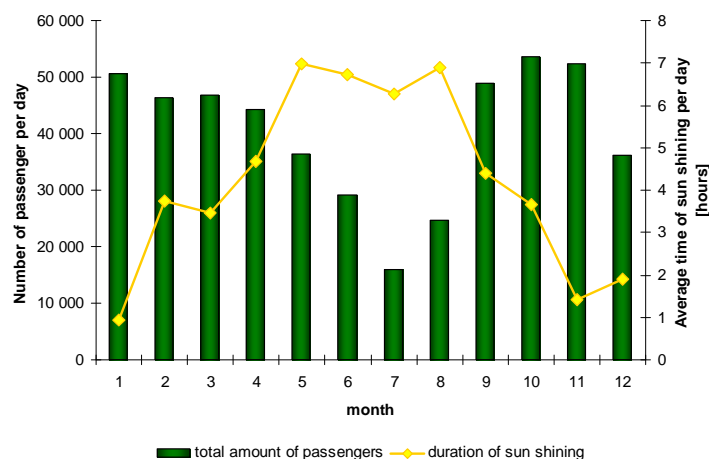


Fig. 1 Daily numbers of passengers and weather (duration of sun shining)

Source: DPmP, CSU

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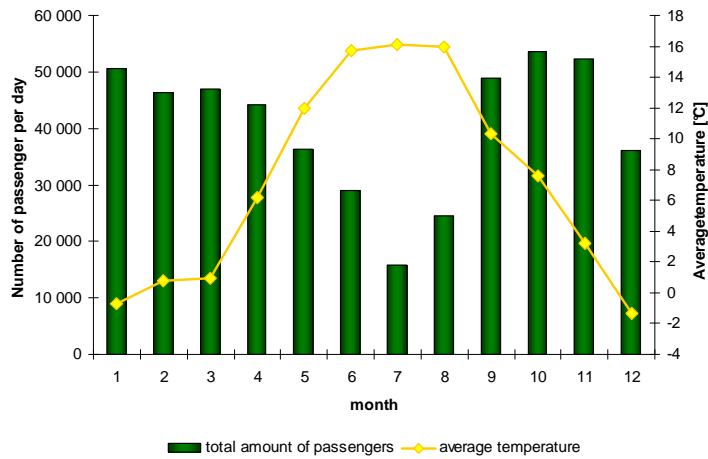


Fig. 2 Daily numbers of passengers and weather (average temperature)  
 Source: DPmP, CSU

### 1.1 Time tickets

The figure below shows the daily number of passengers in different months (in absolute values). It is evident that students are the most dependent on weather of all groups of passengers. It could be because of summer holidays, so the students don't use transport for journeys to school. The same behavior is also seen for pupils, but the differences aren't that big. The seniors group and organization group are hardly affected by seasonal variations, so the weather and others seasonal impacts (as holidays etc.) have no impact on travel interest.

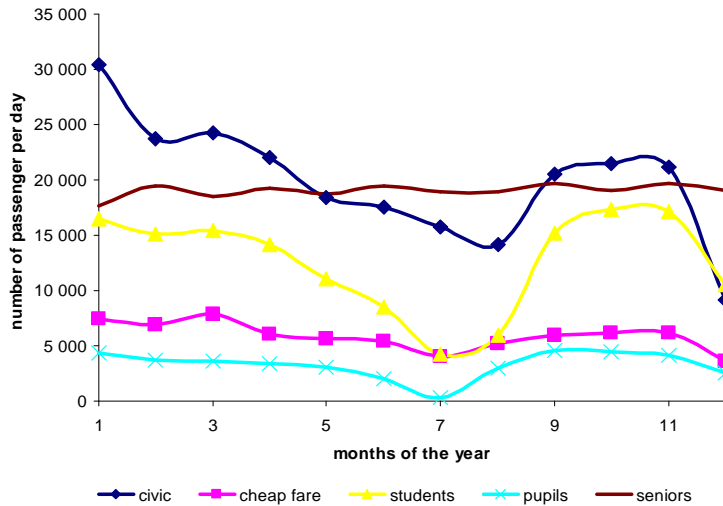


Fig. 3 Daily numbers of passengers in different months by category of passengers  
 Source: DPmP

The variations can also be expressed in percentages, which show how big the difference is between the daily number of passengers in the months and year average. If we use this expression, we can see that the lowest variation is in the group of employees of the Pardubice Transport Company, where the

percentage is lower than 5 for every month. Also the seniors group has the same low deviation. People who can use cheap fare have a maximum deviation lower than 40 %.

On the other hand, the highest deviation is in the pupils group. In the summer months, there is almost 90 % passenger decrease in comparison with the average. The student group is almost the same, but the maximum decrease isn't as big (only 66 %). In the autumn the most passengers travel in October and November, but for the pupils group it is in September. The group is done by the beginning of the school year, whereas pupils start in September and students mostly in October. So it is shown that the variations during the year is due to other factors (such as the time of school year) and these factors for the student group and pupils are more important than the weather.

Civic fares has similar a trend, but the variations are smaller (only about 30 %). Passengers in these groups mostly are not dependent on the school year, so the variations are due to the weather.

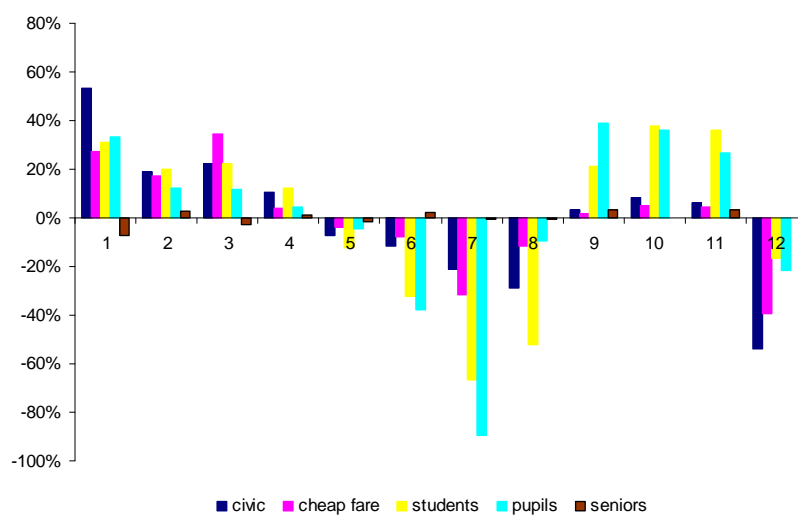


Fig. 4 Relative variation of daily numbers of passengers in different months by category of passengers

Source: DPmP

## 1.2 Individual tickets

This picture is similar as figure3, but there are a number of sealed individual tickets, and not time tickets. Passengers, who pay for there trips by chip card is the category most influenced. And because this category has the bigger share on the total individual tickets, the impact of weather is big there too.

Source: DPmP

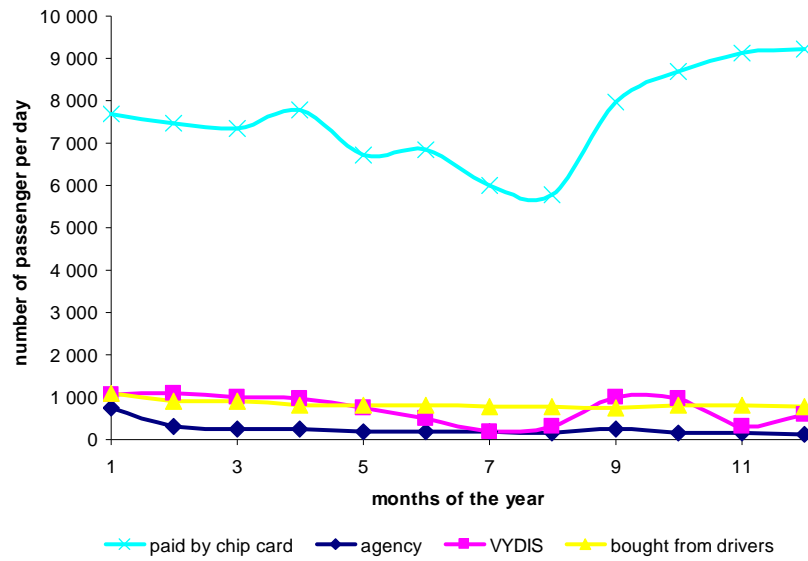


Fig. 5 Daily numbers of passengers in different months by category

Another category is tickets bought from drivers and in the agency. These too are influenced by weather. Passengers who use VYDIS (integrated system of railway and public city transport) are slightly dependent on weather, the picture shows variations of number of passenger for different months of the year.

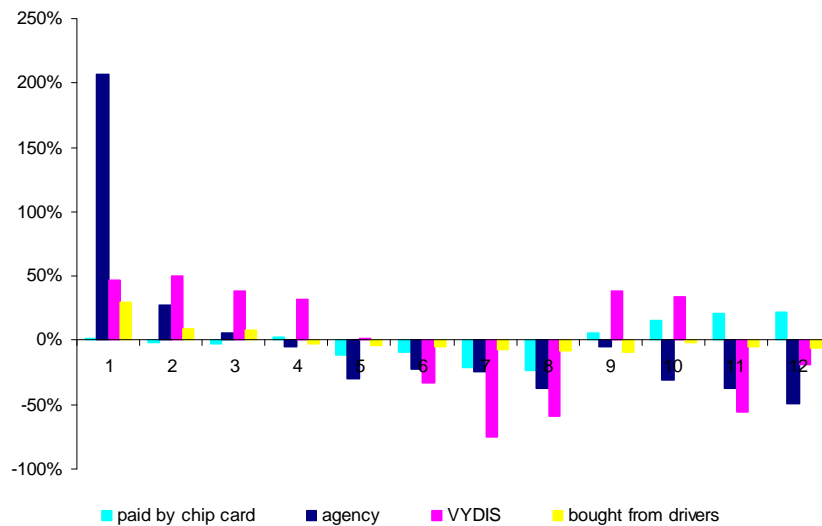


Fig. 6 Relative variation of daily numbers of passengers in different months by category

Source: DPmP

If we use percentages, which show how big the difference is between the daily number of passengers in the months and year averages, we can see the biggest increase in January, and this is for tickets bought in the agency. The reason for this could be that potential passengers want to have reserve of tickets in the beginning of the year.

The Next marked variation is for VYDIS passengers – there is 75 % decrease in July and almost 50 % increase in February. For chip card category the variations are about 20 %.

## 2 Regression and correlation analysis

These analyses are made of daily numbers of passengers of the Pardubice Transport Company for every month of the year 2008 and averages of temperature, precipitations and sun shining measured in the nearest meteorological station in Svratouch. These values are also from the year 2008.

Tab. 9 Correlation matrix

	Average temperature of air	Totals precipitation	Duration of sunshine
Civic	-0,404	-0,243	-0,403
Cheap fare	-0,438	-0,174	-0,338
Students	-0,703	-0,600	-0,711
Pupils	-0,525	-0,550	-0,545
Employees	-0,010	-0,205	0,003
Time tickets – total	-0,554	-0,416	-0,542
Paid by chip card	-0,702	-0,714	-0,800
Agency	-0,430	-0,292	-0,464
VYDIS	-0,563	-0,359	-0,366
Bought from drivers	-0,603	-0,369	-0,540
Individual tickets	-0,756	-0,777	-0,867
External sellers	-0,500	-0,409	-0,500
Total	-0,558	-0,467	-0,598

For given categories, correlation coefficients are negative, which means that there are indirect relationships – with better weather (especially with higher temperature, lower precipitations and with more hours of sun shining) less people use services of the Pardubice Transport Company. But, not every correlation coefficient seems as statistically significant. Statistically significant correlation at 95 % level of significance is only for time tickets for students, total amount of time tickets, individual tickets paid by chip card, total amount of individual tickets and the total amount of all tickets.

The correlation matrix used time series data so it was necessary for confirmation of the correlation, to smooth out the series, and find residues to make correlation analysis for these residues. Based on these

results, only correlation between time tickets for students, total amount of time tickets, individual tickets paid by chip card and the total amount of all tickets and duration of sun shining is confirmed.

At 95 % level of significance there is also statistical significant correlation between time tickets for students and average temperature. The other correlations weren't confirmed.

From the regression analysis, when the sun shining increases 1 hour per day, the passengers using service of the Pardubice Transport Company decrease of 3.7 %. For the category of ticket paid by chip card the elasticity is -4.5 % and for students it's -7.8 %. The temperature elasticity, which expresses change of student passengers given by the change of average temperature of 1°C, is -2.9 %. Verification of regression models, which are based on calculation of these elasticities, at 95 % level of significance didn't prove enough quality of the models.

### **3 Conclusion**

From the completed analysis results, it shows that passenger during decision-making about using services of the Pardubice Transport Company are influenced by weather, especially if it is sunny or not. This correlation was confirmed for category of total amount of tickets, time tickets and students. Correlation on precipitation was proved on the 95 % level of significant as well as correlation on average temperatures.

### **Reference literature**

1. CSU (2009). *Statistical Yearbook of the Pardubický Region 2008*. Retrieved March 29, 2009, from <http://www.czso.cz/xed/edicniplan.nsf/publ/13-5301-08-2008>
2. DPmP. (2008). Tickets sales comparing. Retrieved March 29, 2009, from Dpmp database.