Analysis of the Tourist Sector Investment Appeal Using the PCA in GRETL

Tetyana Kokodey

Sevastopol National Technical University
St. Gogolya 14,
99011 Sevastopol, Ukraine
tkl78@sevcable.net

The article discusses econometrical modeling of a generalized investment appeal indicator for a tourist company and for a tourist sector of a region by the example of Crimea. The latter is further called the rating of investment appeal for a region. The database of the main financial and activity indicators for Crimean tourist companies (2003-2007) was used to calculate the indicators.

Investment policy realization in Ukraine, specifically in the tourist sector, depends on scientifically proved undertakings to attract investments. These undertakings are planned using various econometrical methods to analyze investment appeal of a tourist company.

Table 1 shows data describing the volume of direct foreign investment into the tourist sector of Crimea during 2003-2007yrs.

Table 1. The volume of direct foreign investments into the tourist sector of Crimeaза 2003-2007 yrs. (end of year)

	unit	2003	2004	2005	2006	2007
TOTAL in Crimea	thousand dollars	234045,1	331179,9	460367,0	576971,4	726194,9
The volume of direct foreign investments into the tourist sector of Crimea	thousand dollars.	150312,1	174093,3	217876,7	259879,8	288941,4
Including: Sanatoriums	thousand dollars.	101611,0	112986,6	125497,0	127341,1	143026,0
Per cent to the volume of direct foreign investments	%	67,6	64,9	57,6	49,0	49,5
Tourist companies	thousand dollars.	3908,1	4700,5	37910,5	52495,7	53165,2
Per cent to the volume of direct foreign investments	%	2,6	2,7	17,4	20,2	18,4

The data above shows the increase in the direct foreign investments into Crimea during 2003-2007, nevertheless the relative level stays low as shown on Figure 1.

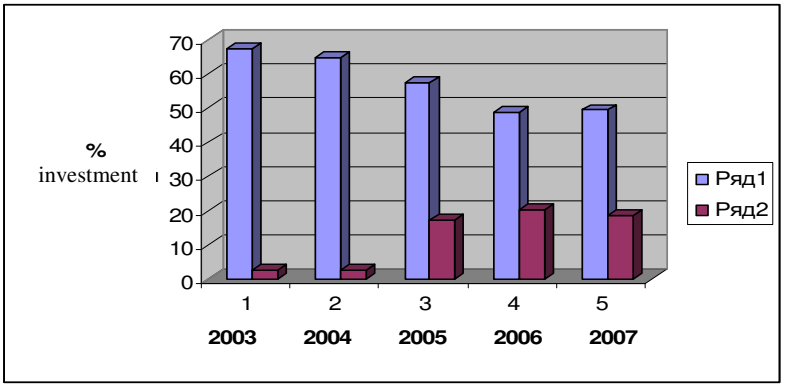
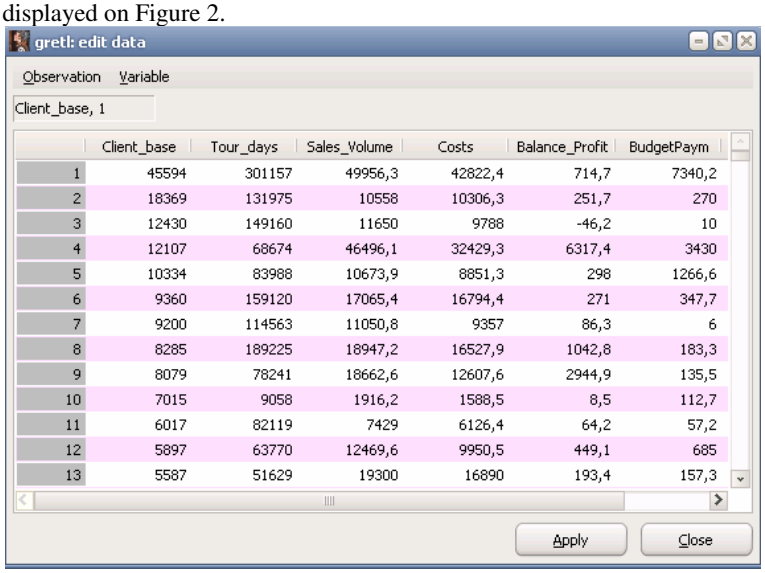


Fig 1. Dynamics of direct foreign investments into the tourist sector of Crimea during 2003-2007 yrs.

The rating of investment appeal for a region, calculated using econometrical methods, can be used as a tool to explain the dynamics presented above, as far as it is a universal instrument of the overall independent assessment of the current state and potential of a region's tourist sector. The rating also provides the key information for an investor regarding both generalized assessment and projections of the operational efficiency of all the region's company.

There are several means to determine the rating as an integral indicator of investment appeal. One of them is GRETL www.sourceforget.net (GNU Regression Econometrics and Time Series Library) open source econometrical software procedures application.

The rating of investment appeal for a region is calculated based on the main financial and activity indicators of all functioning tourist companies of Crimea, using data from 2003 to 2007, fragment of which is displayed on Figure 2.



	Client_base	Tour_days	Sales_Volume	Costs	Balance_Profit	BudgetPaym
1	45594	301157	49956,3	42822,4	714,7	7340,2
2	18369	131975	10558	10306,3	251,7	270
3	12430	149160	11650	9788	-46,2	10
4	12107	68674	46496,1	32429,3	6317,4	3430
5	10334	83988	10673,9	8851,3	298	1266,6
6	9360	159120	17065,4	16794,4	271	347,7
7	9200	114563	11050,8	9357	86,3	6
8	8285	189225	18947,2	16527,9	1042,8	183,3
9	8079	78241	18662,6	12607,6	2944,9	135,5
10	7015	9058	1916,2	1588,5	8,5	112,7
11	6017	82119	7429	6126,4	64,2	57,2
12	5897	63770	12469,6	9950,5	449,1	685
13	5587	51629	19300	16890	193,4	157,3

Fig 2. Fragment of the financial and activity indicators database for Crimean companies in 2007. in Gretl 1.7.1

The following individual indicators were used in calculations, names in parenthesis indicate the corresponding variable name in Gretl:

X_1 - Number of tourists (Client base);
X_2 - Number of tour days (TourDays);
X_3 - Sales Volume (SalesVolume);
X_4 - Balance Profit (BalanceProfit);

X_5 - Budget Payments (BudgetPaym);
X_6 - Costs (Costs).

As far as the indicators $x_1,...,x_6$ are correlated among each other in the substantial extent, the principal components method can be applied to calculate one the most significant principal component y_1 (with the maximum contribution into the overall dispersion of $x_1,...,x_6$) as a linear function of the original indexes, formula (1).

The principal component y_1 can be used as a generalized index of the investment appeal for a company, as far as it contains the majority of information about the company from $x_1,...,x_6$.

$$y_1(x) = w_{11}(\frac{x_1 - \bar{x}_1}{\sigma_1}) + ... + w_{61}(\frac{x_6 - \bar{x}_6}{\sigma_6}); \quad (1)$$

where $\bar{x}_j$ and σ_j — the average and standard deviation of x_j;

w_{j1} – coefficients of the most significant principal component ($\sum_{j=1}^{6} w_{j1}^2 = 1$);

y_1 – the most significant principal component - a generalized index of the investment appeal for a company.

The value λ_1 is the maximum eigenvalue for the first principal component y_1. As far as λ_1 generalizes the majority of observations $x_1,...,x_6$, it can be considered the rating of investment appeal for a region in a given year and further used to track the dynamics of a region's investment appeal.

According to the modeling results obtained in Gretl (Figure 3), the generalized indicator of investment appeal for a company (y_1) for the year 2007 is determined using formula (2):

$$Y1_{2007} = 0{,}452\text{ClientBase} + 0{,}428\textit{TourDays} + 0{,}459\textit{SalesVolume} + 0{,}453\text{Costs} + \\ + 0{,}152\textit{Balance}\,\text{Pr}\,\textit{ofit} + 0{,}416\textit{BudgetPayments} \quad (2)$$

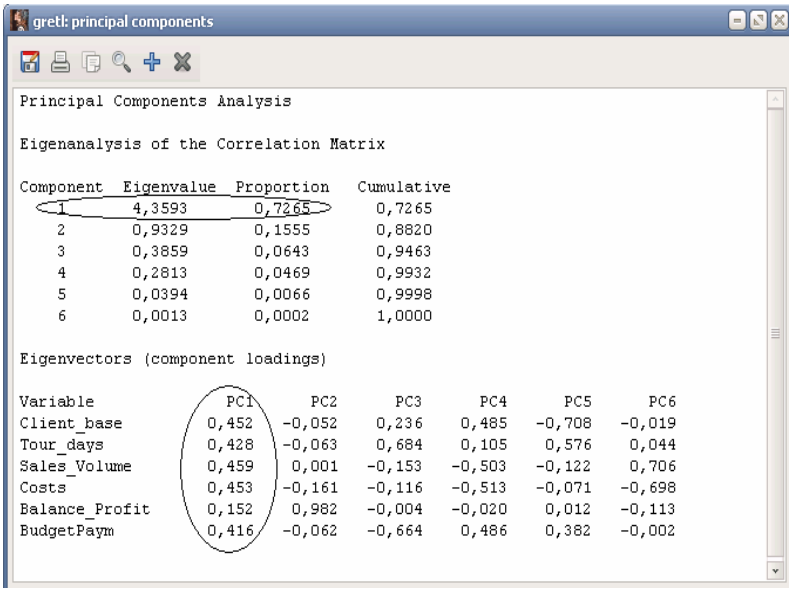


Fig. 3. Modeling results in Gretl using the Principal Components Method for the year 2007

The per cent of initial data $x_1,...,x_6$ embraced by y_1 and included into the formula (2) is 72,65% (Proportion on Figure 3).

Thus, eigenvalue $\lambda_{2007} = 4{,}3593$ can be considered the rating of investment appeal for a region in 2007.

Similar calculations were conducted using 2006 data (Figure 4), formula (3) was obtained:

$$Y1_{2006} = 0{,}457\text{ClientBase} + 0{,}434 TourDays + 0{,}451 SalesVolume + 0{,}453\text{Costs} + \\ + 0{,}06 Balance\,\text{Pr}\,ofit + 0{,}436 BudgetPayments \quad \textbf{(3)}$$

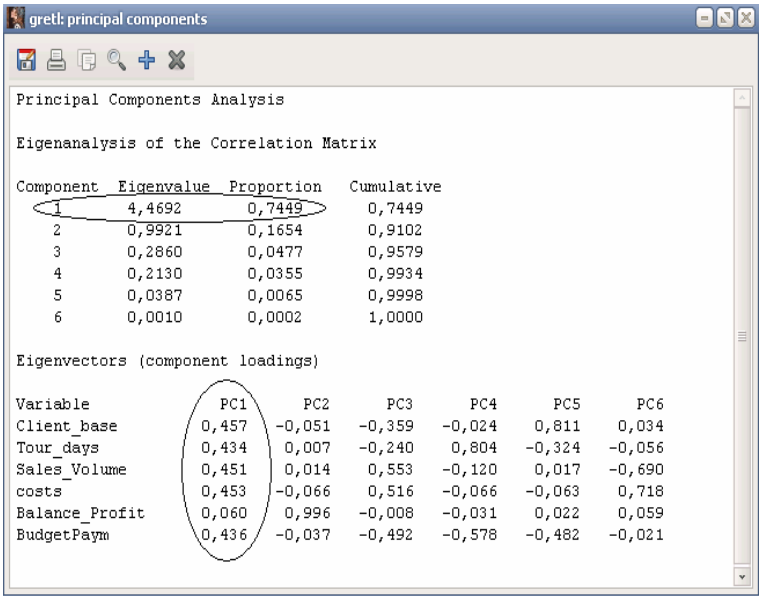


Fig. 4. Modeling results in Gretl using the Principal Components Method for the year 2006

The per cent of initial data $x_1,...,x_6$ embraced by y_1 and included into the formula (3) is 74,49% (Proportion on Figure 4).

Thus, eigenvalue $\lambda_{2006} = 4{,}4692$ can be considered the rating of investment appeal for a region in 2006.

Similar calculations were conducted using 2005 data (Figure 5), formula (4) was obtained:

$$Y1_{2005} = 0{,}447\text{ClientBase} + 0{,}446 TourDays + 0{,}472 SalesVolume + 0{,}469\text{Costs} - \\ - 0{,}004 Balance\,\text{Pr}\,ofit + 0{,}399 BudgetPayments \quad (4)$$

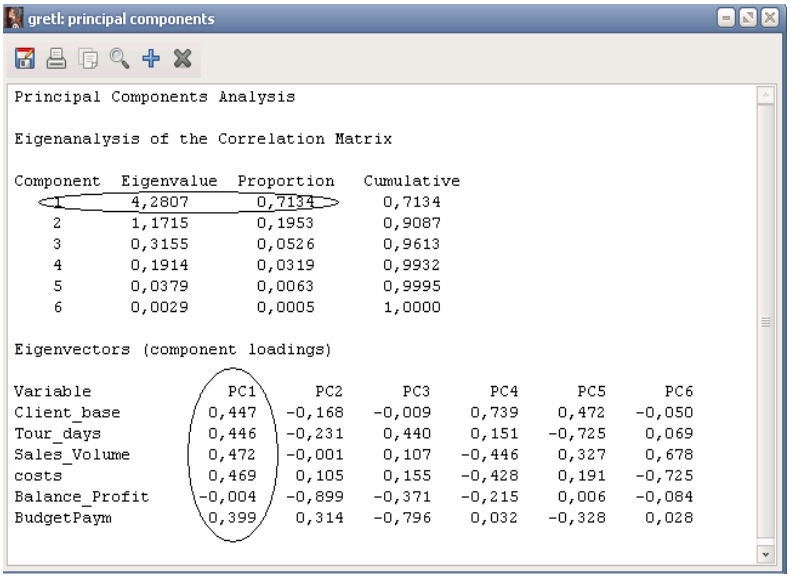


Fig. 5. Modeling results in Gretl using the Principal Components Method for the year 2005

The per cent of initial data $x_1,...,x_6$ embraced by y_1 and included into the formula (4) is 71,34% (Proportion on Figure 5).

Thus, eigenvalue $\lambda_{2005} = 4{,}2807$ can be considered the rating of investment appeal for a region in 2005.

The modeling results above can be summarized in the table 2 below.

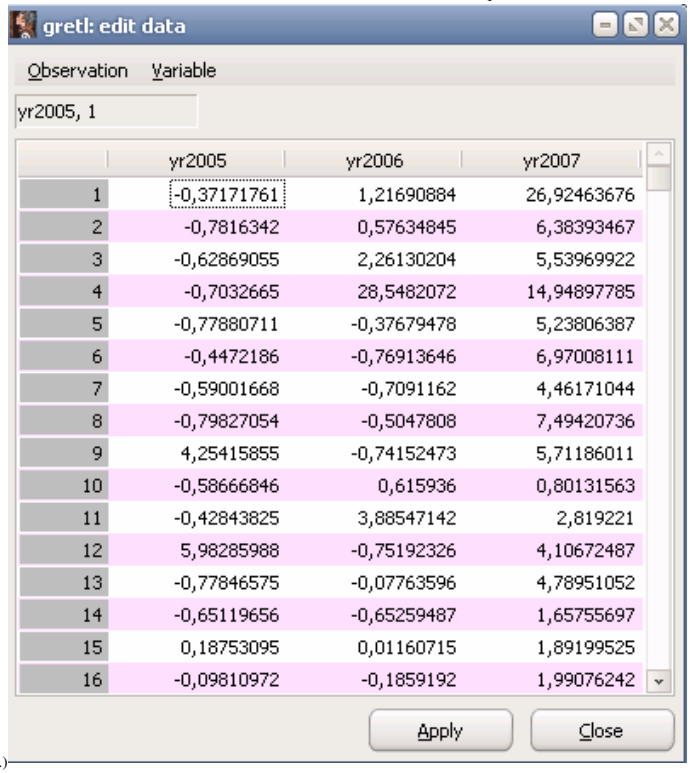
Table 2. Modeling results for the Crimean Region tourist sector investment appeal.

year	The generalized index of the investment appeal for a company, $Y1_i$	Rating of the investment appeal for Crimea, λ_i
2005	$Y1_{2005} = 0{,}447ClientBase + 0{,}446TourDays + 0{,}472SalesVolume + 0{,}469Costs - -0{,}004Balance\,Profit + 0{,}399BudgetPayments$	4,2807
2006	$Y1_{2006} = 0{,}457ClientBase + 0{,}434TourDays + 0{,}451SalesVolume + 0{,}453Costs + +0{,}06BalanceProfit + 0{,}436BudgetPayments$	4,4692
2007	$Y1_{2007} = 0{,}452ClientBase + 0{,}428TourDays + 0{,}459SalesVolume + 0{,}453Costs + +0{,}152Balance\,Profit + 0{,}416BudgetPayments$	4,3593

Fig. 6 shows a fragment of the calculated database of $Y1_{2005}, Y1_{2006}, Y1_{2007}$ for every tourist company in Crimea.

Thus, the principal component method allows for generalization and synthesis of indicial financial and activity indicators $x_1,...,x_6$ for individual companies in a certain year into a generalized indicator of a company's investment appeal y_1

(most significant principal component) and also for calculation of the investment appeal rating for a region's tourist sector λ_1 (eigenvalue for y_1.)



	yr2005	yr2006	yr2007
1	-0,37171761	1,21690884	26,92463676
2	-0,7816342	0,57634845	6,38393467
3	-0,62869055	2,26130204	5,53969922
4	-0,7032665	28,5482072	14,94897785
5	-0,77880711	-0,37679478	5,23806387
6	-0,4472186	-0,76913646	6,97008111
7	-0,59001668	-0,7091162	4,46171044
8	-0,79827054	-0,5047808	7,49420736
9	4,25415855	-0,74152473	5,71186011
10	-0,58666846	0,615936	0,80131563
11	-0,42843825	3,88547142	2,819221
12	5,98285988	-0,75192326	4,10672487
13	-0,77846575	-0,07763596	4,78951052
14	-0,65119656	-0,65259487	1,65755697
15	0,18753095	0,01160715	1,89199525
16	-0,09810972	-0,1859192	1,99076242

Fig 6. A fragment of the calculated database of $Y1_{2005}$, $Y1_{2006}$, $Y1_{2007}$

The same calculation method was used to estimate $\lambda_{2004} = 4{,}01$ and $\lambda_{2003} = 3{,}91$

In order to estimate the dynamics of the calculated ratings in the given time-frame (2003-2007) and to make the projections for the period (2008-2012), the trend analysis method (one of the methods for time series analysis) was applied in Gretl.

According to the modeling results using Ordinary Least Squares method (Figure 7) the trend model of the time series of λ_1 was developed, formula (5):

$$\lambda_1 = 3{,}7985 + 0{,}13578t + \varepsilon, \qquad (5),$$

где t - year;

ε - random error (residuals).

Model (5) was developed based on prior obtained values of $\lambda_{2003}, \lambda_{2004,} \lambda_{2005}, \lambda_{2006,} \lambda_{2007}$.

Prediction of the rating λ_1 for the time frame (2008-2012) is shown on Figure 8.

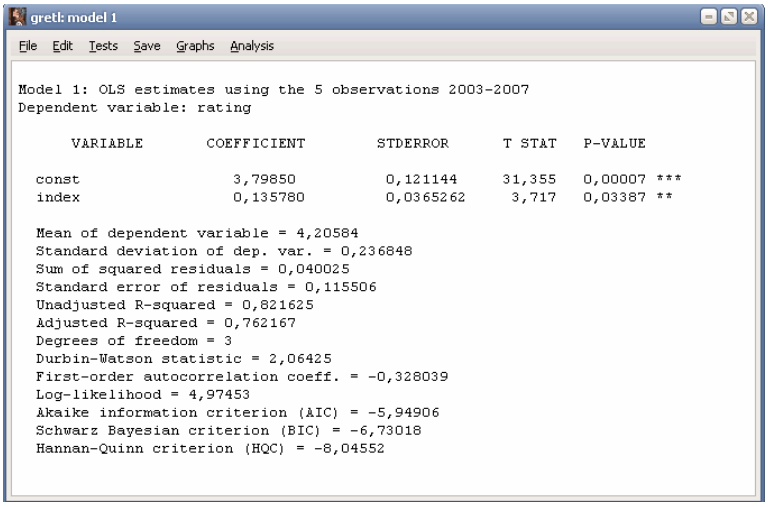
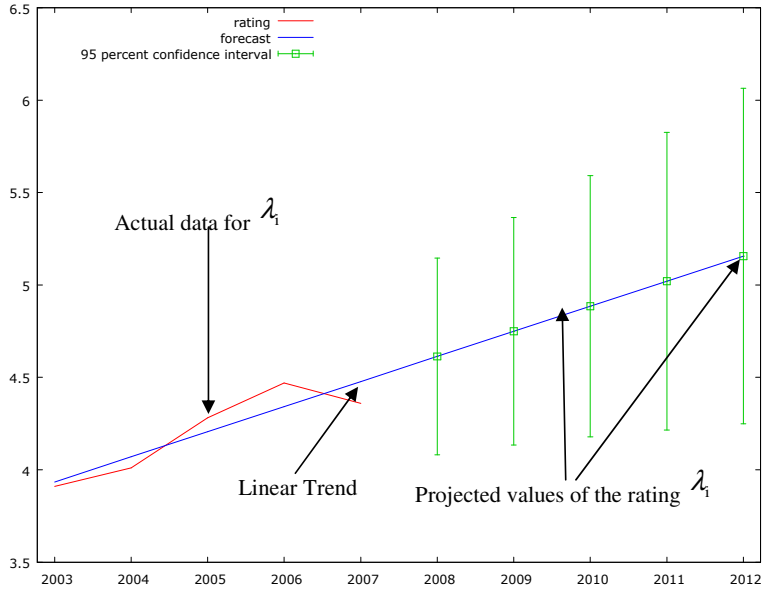


Fig 7. Trend modeling results for λ_i .

The model (5) can be considered adequate and its parameters - valid with a 5% probability of an error.



For 95% confidence intervals, t(3, .025) = 3,182

Obs	Prediction for λ_i (Rating)	std. error	95% confidence interval
2008	4,61318	0,167384	(4,08049, 5,14587)
2009	4,74896	0,193279	(4,13386, 5,36406)
2010	4,88474	0,222181	(4,17766, 5,59182)
2011	5,02052	0,253061	(4,21517, 5,82587)
2012	5,15630	0,285279	(4,24841, 6,06419)

Fig 8. Dynamics and projection for λ_i (Crimea investment appeal rating)

Overall positive dynamics of the investment appeal rating for Crimea can be indicated during the period 2003-2007, (Figure 8). The rating value is going to reach 4,61318 in 20008 and 5,15630 in 2012 according to the projections using the linear trend model (5).

Modeling results obtained in the research allow to make a conclusion that investment appeal of Crimea is going to increase 5,82% in 2008 and 18,28% in 2012 due to the positive dynamics of individual financial and activity indicators of tourist companies in the region.