Janusz Dąbrowski*

Application of Difference Analysis Perception in Comparison of Calculation of the Effects of Floods

1. Introduction

The theory of direct observations of differences implies that the value was measured independently twice [4]. We can assume the values for the variety of precise observations respectively as: p_1 and p_2, and the measurement results by W and W_2. At the same time W_2 will mean a valuation carried out by experts representing a given municipality, and W the valuation is made by a committee representing the Treasury in the person of the Governor. The difference observations Δw can be written as:

$$\Delta w = W_2 - W, \text{ that is } W_2 = W + \Delta w \tag{1}$$

The weighted average will therefore:

$$x = \frac{p_1 \cdot W + p_2 \cdot (W + \Delta w)}{p_1 + p_2} = W + \frac{p_2}{p_1 + p_2} \cdot \Delta w \tag{2}$$

Amendments V_1 and V_2 take the values:

$$V_1 = x - W = W + \frac{p_2}{p_1 + p_2} \cdot \Delta w - W = \frac{p_2}{p_1 + p_2} \cdot \Delta w \tag{3}$$

$$V_2 = x - W - \Delta w = W + \frac{p_2}{p_1 + p_2} \cdot \Delta w - W - \Delta w = \frac{1 - p_2}{p_1 + p_2} \cdot \Delta w = -\frac{p_1}{p_1 + p_2} \cdot \Delta w \tag{4}$$

* The State School of Higher Vocational Education, Jarosław, Poland

The value $V_1 : V_2$ takes respectively:

$$V_1 : V_2 = -p_2 : p_1 = -\frac{1}{p_1} : \frac{1}{p_2} \tag{5}$$

While calculating the amendments, the increase Δw is split between the observations in proportion to the weight p_1 and p_2.

The average error unit can therefore be calculated from the formula:

$$m_0 = \sqrt{\frac{p_1 \cdot V_1^2 + p_2 \cdot V_2^2}{2-1}} \tag{6}$$

The arithmetic mean of the average error can be calculated from the formula:

$$m_x = \frac{m_0}{\sqrt{p_1 + p_2}} \tag{7}$$

For equally accurate observations, namely those for which the models shown above can be written respectively:

$$x = \frac{W + (W + \Delta w)}{1+1} = W + \frac{1}{2} \cdot \Delta w \tag{8}$$

$$V_1 = x - W = W - W + \frac{1}{2} \cdot \Delta w = \frac{1}{2} \cdot \Delta w \tag{9}$$

$$V_2 = x - W - \Delta w = W + \frac{1}{2} \cdot \Delta w - W - \Delta w = -\frac{1}{2} \cdot \Delta w \tag{10}$$

$$m_0 = \sqrt{\frac{V_1^2 + V_2^2}{2-1}} = \sqrt{\left(\frac{1}{2} \cdot \Delta w\right)^2 + \left(\frac{1}{2} \cdot \Delta w\right)^2} = \frac{\Delta w}{\sqrt{2}} \tag{11}$$

$$m_x = \frac{m_0}{\sqrt{2}} = \frac{\Delta w}{2} \tag{12}$$

These formulas are applicable only for the observations burdened with only random errors. In the data presented in this work there is a strong systematical factor. It can be *a priori* assumed that the valuation done for the community will be fraught with a tendency to overestimate, yet the valuations done for the Governor will have a contrary tendency.

2. Comparison of Pairs of Observations to Estimate the Effects of Floods

The author examined 142 pairs of valuations in Podkarpackie made by different people from the government for the purpose of flood damage estimates. All valuations related to flood damage in May and June 2010. Because of the slight timing differences in the valuation, the influences of the real estate market environment were completely omitted [1–3]. A preliminary analysis of the character values Δw are presented in table 1. An even distribution of characters Δw and the sum of Δw close to zero, is a prerequisite for an absence of systematic errors. Deviations from the above-mentioned principles may be evidence of the systematic errors of observation order.

Table 1. Statement of Marks (signum) values for pairs of observations analyzed

Δw	$\Delta w < 0$	$\Delta w = 0$	$\Delta w > 0$
Number of cases	3	34	105
Percentage Δw [%]	2	24	74

Results of trade test values in table 1 shows that the data set is marred by a systematic factor, which we call a "strong tendency of self-government to overestimate the effects of flooding".

Accordingly, in the statistical analysis we calculated the factor of systematic and fundamental statistics by the formulas:

$$\mu = \frac{\sum_{i=1}^{n} \Delta w}{n} \tag{13}$$

$$m_{\Delta w} = \sqrt{\frac{\sum_{i=1}^{n} p(\Delta w - \mu)^2}{n-1}} \tag{14}$$

$$m_0 = \sqrt{\frac{\sum_{i=1}^{n} p(\Delta w - \mu)^2}{2(n-1)}} \tag{15}$$

$$m_x = \frac{1}{2}\sqrt{\frac{\sum_{i=1}^{n} p(\Delta w - \mu)^2}{n-1}} \tag{16}$$

and after inserting the data we obtained the following results:

$$\mu = 2\,530\,583 \text{ PLN}$$

$$m_{\Delta w} = 6\,986\,240 \text{ PLN}$$

$$m_0 = 4\,940\,018 \text{ PLN}$$

$$m_x = 3\,493\,120 \text{ PLN}$$

Even taking into account the total value of the estimated loss of 1 076 075 352 PLN for 142 local governments, the above statistics may be questionable as to its credibility because of the large variation of the estimated amounts of flood damage. Consequently, the lists were ranked according to the amount of value and the results in two tables of twenty local authorities following the criterion of the estimated losses.

Table 2. Balance sheet of twenty lowest sums of estimated flood loses in the Podkarpackie Province

No.	Commune/Poviat	W_2 – estimation done by the local government	W – estimation done by Main Office of the Podkarpackie Province	$\Delta w = W_2 - W$	$\Delta w / W_2 \cdot 100$ [%]
1	UM Łańcut	91 600	91 600	0	0
2	UG Majdan Królewski	107 000	72 000	35 000	33
3	UG Trzebownisko	122 000	122 000	0	0
4	UG Radymno	135 000	135 000	0	0
5	UG Pawłosiów	137 200	137 200	0	0
6	UG Jarosław	196 500	196 500	0	0
7	UG Przemyśl	212 100	212 100	0	0
8	UMiG Ustrzyki Dolne	278 276	241 576	36 700	13
9	UG Czarna	305 000	275 000	30 000	10
10	UMiG Rudnik	325 000	325 000	0	0
11	UG Lubaczów	332 102	285 000	47 102	14
12	UMiG Głogów Małopolski	336 000	336 000	0	0
13	UG Dzikowiec	360 000	360 000	0	0
14	UG Pysznica	389 508	389 508	0	0
15	UG Krzeszów	409 840	409 840	0	0
16	UG Niwiska	442 000	317 000	125 000	28
17	UG Łańcut	481 600	481 600	0	0
18	UG Besko	500 000	400 000	100 000	20
19	UG Dubiecko	540 000	540 000	0	0
20	UG Tyrawa Wołoska	616 500	494 000	122 500	20

Source: own study based on data of The Main Office of the Podkarpackie Province in Rzeszów

The results presented in the table 2 show a big conformity of both valuations. Only in the case of one valuation among twenty analysed ones, the discrepancy between valuations exceeded 30%. The discrepancy over 20% between researched valuations was noted only in four cases in twenty analysed ones. In as many as 13 cases the conformity of both valuations was identical which proves the big credibility of prepared valuations. The basic statistics for the data contained in the table 2 are presented below:

$$\mu = \frac{\sum_{i=1}^{n} \Delta w}{n} = 24\ 815 \text{ PLN}$$

$$m_{\Delta w} = \sqrt{\frac{\sum_{i=1}^{n} p(\Delta w - \mu)^2}{n-1}} = 42\ 305 \text{ PLN}$$

$$m_0 = \sqrt{\frac{\sum_{i=1}^{n} p(\Delta w - \mu)^2}{2(n-1)}} = 29\ 914 \text{ PLN}$$

$$m_x = \frac{1}{2}\sqrt{\frac{\sum_{i=1}^{n} p(\Delta w - \mu)^2}{n-1}} = 21\ 152 \text{ PLN}$$

Systematic factor of 13 in 20 cases did not exceed 10% of the value estimated by the local government. It can be claimed that the divergences in the valuations appearing as a result of the presence of the systematic factor slightly distorting the sums of estimated loses, are put within bounds of tolerance and they do not exceed commonly recognised standards. The fact that the value of the systematic factor, if it does not assume the zero value it always is positive irrefutably proves the tendency to overrate the estimated loss or underrating by the staff representing the voivod.

Figure 1 allows to graphically estimate the presented data and it confirms previously formed conclusions.

The data presented in table 3 are slightly different. The table show twenty valuations of flood losses where biggest values of estimated losses were noted.

The data presented in table 3 show great discrepancy between both estimations. Only eight valuations did not exceed the level of 30% difference between two estimations. The greatest discrepancy was 88%, and the smallest 4%. Great value of the systematic factor 14 155 155 PLN makes preparing additional statistics totally useless. The average level of estimation discrepancy exceeds 38%, so it does not meet any standards expected for experts.

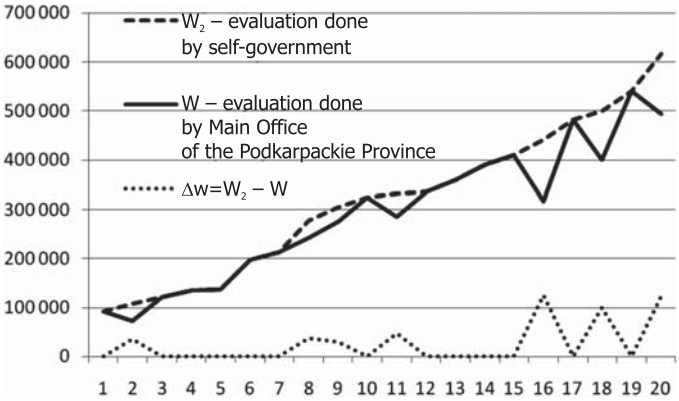

Fig. 1. Specification of valuations and differences of Floyd results for twenty lowest values of loss (in PLN)

Source: own study based on data of The Main Office of the Podkarpackie Province in Rzeszów

Table 3. Balance sheet of twenty highest sums of estimated flood losses in the Podkarpackie Province

No.	Commune/Poviat	W_2 – estimation done by the local government	W – estimation done by Main Office of the Podkarpackie Province	$\Delta w = W_2 - W$	$\Delta w / W_2 \cdot 100$ [%]
1	UMiG Brzostek	14 209 010	7 649 350	6 559 660	46
2	UG Wielopole S	14 743 114	9 440 000	5 303 114	36
3	UG Mielec	15 589 000	8 089 000	7 500 000	48
4	UMiG Pilzno	18 678 000	17 088 009	1 589 991	9
5	Mielec district	19 974 481	13 080 000	6 894 481	35
6	UMiG Ropczyce	20 098 558	10 316 920	9 781 638	49
7	Łańcut district	20 272 000	11 612 000	8 660 000	43
8	Strzyżów district	22 282 000	15 852 000	6 430 000	29
9	Sanok district	22 751 730	14 423 500	8 328 230	37
10	UG Dębica	29 485 944	17 082 500	12 403 444	42
11	Tarnobrzeg district	30 886 117	22 446 000	8 440 117	27
12	Krosno district	32 172 644	13 728 000	18 444 644	57
13	UG Gorzyce	32 739 979	24 051 479	8 688 500	27
14	Dębica district	37 923 180	33 299 500	4 623 680	12
15	UM Jasło	39 112 868	27 401 000	11 711 868	30
16	UG Frysztak	50 542 330	5 959 800	44 582 530	88
17	UM Tarnobrzeg	52 320 815	50 270 815	2 050 000	4
18	Governor of the province	68 425 640	29 278 700	39 146 940	57
19	Rzeszów district	70 411 000	25 897 000	44 514 000	63
20	Jasło district	92 749 271	65 299 000	27 450 271	30

Source: own study based on data of The Main Office of the Podkarpackie Province in Rzeszów

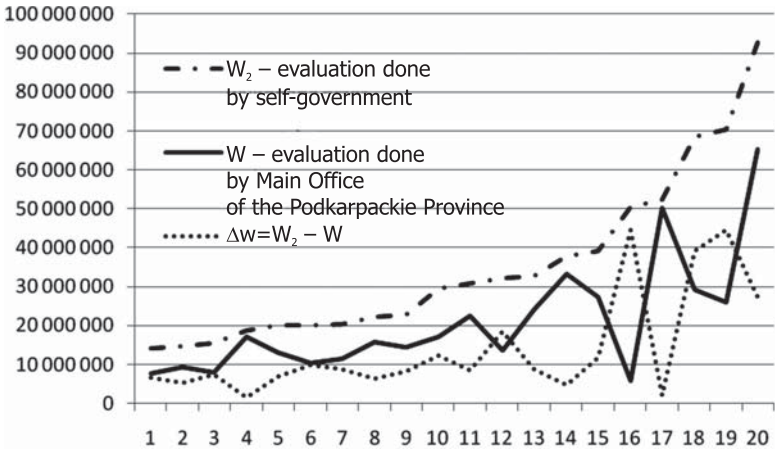

Fig. 2. Balance sheet of valuations and differences of flood results for twenty biggest values of loss (in PLN)

Source: own study based on data of The Main Office of the Podkarpackie Province in Rzeszów

Figure 2 shows results presented in table 3. The discrepancies between valuations are very big which strongly undermines the credibility of prepared estimations. It is also hard to assume that the people preparing them for small flood losses do their work reliably whereas with bigger sums of money they do not respect the standards and prepare very high valuations.

3. The Valuation of the Flood Losses Versus Feasible Possibilities of the State

Very big discrepancies of the flood losses between two statements increase proportionally to the value of the flood losses. The sums of losses caused by the flood only in May and June exceeded one billion PLN. These were the most serious losses of property in the recent years but it should be remembered that in 2010 there were four floods, not to mention minor floodings.

Figure 3 shows the values of paid sums as flood losses in the years 2007–2010.

The balance sheet of the payments for the local governments in the years 2007–2010 in comparison with the earlier data estimating flood losses shows a great discrepancy between factual losses and sums paid for the local governments. The differences between sums received from The State Treasury and actual expenses will have to be covered by the local governments from their own budgets. Unfortunately in many cases there is no reconstruction of the state property due to the lack of financial resources.

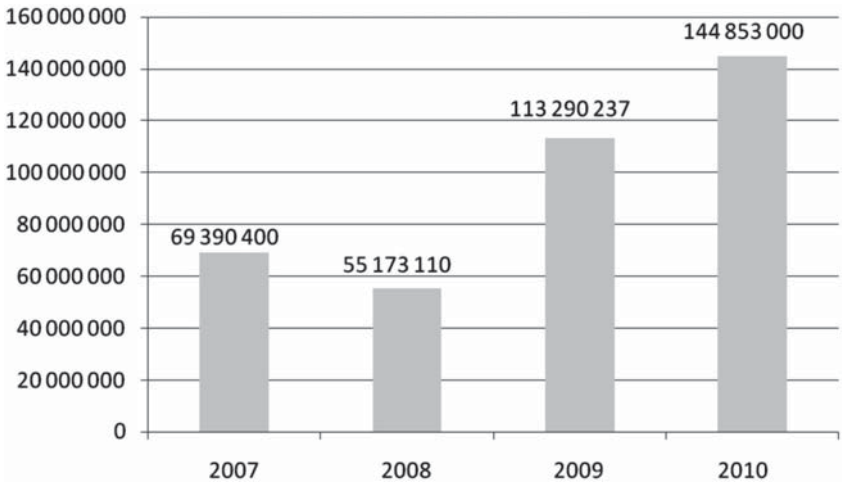

Fig. 3. Balance sheet of the sums paid for the local governments of the Podkarpackie Province in the years 2007–2010 as flood losses (in PLN)

Source: own study based on data of The Main Office of the Podkarpackie Province in Rzeszów

4. Conclusions

- Analysis of differences in perceptions can be used to compare pairs of valuations for sufficiently large data sets.
- Comparison of 142 pairs of valuations made on the basis of Secocenbud pricing proved there is a strong systematic factor for the studied valuations.
- High reliability of estimates was observed for the results of flood losses for the sums of a few hundred thousand and a low reliability for losses over a few million.
- Systematic factor is probably the result of two opposing tendencies, i.e. the natural tendency to overestimate the amount estimated by the government and the lack of financial resources in the state budget to under-estimated loss by the party representing the State Treasury.
- Studies on the effects of flood in 2010 in comparison to the amounts disbursed for the period 2007–2010 show that fixed assets are reconstructed at the level of 10–20% compared to the total losses.
- It would be very valuable to compare the flood losses with the sums needed to build adequate flood protection. Unfortunately, the author has no relevant data. The practice of many countries shows that flood prevention is often several times cheaper than removing flood results. It should be noted that the data collected do not cover losses of personal property of residents of Podkarpackie Province.

References

[1] Begg D., Fisher S., Dornbush R.: *Makroekonomia.* PWE, Warszawa 2007.
[2] Czaja J., Parzych P.: *Szacowanie rynkowej wartości nieruchomości w aspekcie Międzynarodowych Standardów wyceny.* Stowarzyszenie Naukowe im. Stanisława Staszica, Kraków 2007.
[3] Dąbrowski J.: *Zastosowanie metod i algorytmów statystycznych do wyznaczenia parametrów globalnych.* Studia i Materiały TNN, Olsztyn 2009.
[4] Kochmański T.: *Rachunek wyrównawczy*. Państwowe Wydawnictwa Szkolnictwa Zawodowego, Warszawa 1952.