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Geoid Computations in the Italian Area

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Summary. — A gravimetric geoid has been determined in the italian area: this paper reports procedures and results. The data which have been used are the gravity anomalies supplied by BGI.

A collocation procedure has been applied locally using the Rapp ('79) 180 × 180 model as reference field. The geoidal height m.s.e. is almost everywhere less than 0.5 m on the land. Vertical deflections are estimated too and the discrepancies with the measured values show significant large values in the tectonically active areas.

A comparison is made with the Cruz and Rapp geoid showing significant systematic differences.

CALCOLO DEL GEOIDE NELL'AREA ITALIANA.

Sommario. — Del calcolo di un geoide gravimetrico nell'area italiana si riportano procedure e risultati. Si è fatto uso delle anomalie della gravità fornite dal BGI.

La procedura è basata sulla collocazione applicata localmente con riferimento al modello di Rapp ('79), 180 × 180. Lo e.q.m. delle altezze sul geoide è quasi ovunque inferiore a 0.5 m sulla terraferma. Si stimano anche le deviazioni della verticale; le discrepanze con i valori misurati sono maggiori nelle zone tettonicamente attive.

Un confronto con il geoide di Cruz e Rapp mostra un significativo sistematismo nelle differenze.

INTRODUCTION

The present paper reports the status of the research developed by the Milan group with the cooperation of dr. S. Zerbini and dr. P. Gasperini, of the University of Bologna, in the field of computational physical geodesy. The final tasks of the research are the comparisons of several methods for determining the anomalous potential (T), represented as usual by the geoid or better by the quasi-geoid [1], and the actual computation of the geoid in the Italian region with the best possible accuracy (target ± 20 cm).

The first step of the research was the computation of an astrogeodetic geoid as reported in the 2nd International Symposium on the European and Mediterranean Geoid (Rome, September 1982).

Wath we present here is the 1983 step of the research, i.e. mainly the computation of a first gravimetric geoid.

1. — GENERAL INFORMATION ABOUT THE METHOD

1.1. - THE COLLOCATION PROCEDURE

The collocation procedure has been used at this step of the research, for it is particularly simple to use (no a-priori smoothing and interpolation of data is required) flexible (any kind of data can be used) and powerful (any kind of geodetic quantity can be predicted).

The program we have used is the C.C. Tscherning program with a few modifications (see C.C. Tscherning, 1974).

The program allows a three-steps collocation, but only two steps have been used till now, the first of which is the computation of the requested quantities using a global model of the earth anomalous potential represented by spherical harmonic coefficient.

1.2. - PARTITIONING OF ITALY INTO ZONES

The Italian region has been partitioned into 13 rectangular zones which have been trated independently; this partitioning was necessary in order to avoid too long, and expensive, computations.

It is not a completely satisfactory procedure, but at this stage it seems to be the best compromise between a completely rigorous (or at least more rigorous) procedure, and the need to reduce the computations to a manageable amount.

Justifications and problems of this procedure will be pointed out later on in the paper. Table 1 and figure 1 illustrate the zone boundaries.

(1) For the sake of brevity we shall use throughout the paper the word «geoid» instead of «quasi-geoid».

2. — THE DATA

2.1. - GRAVITY DATA

The gravity data we used are the data collected and distributed by the B.G.I., which we like to thank for the kind cooperation.

10116 data have been supplied, 6551 of which are land data and 3564 are marine data. Only land data have been used, mainly because of the difficulty of finding reliable weights for the two kinds of measurements.

TABLE 1
ZONES BOUNDARIES

Zone	φ	λ
1	44.00 ÷45.50	8.00 ÷11.00
2	44.00 ÷46.00	10.00 ÷13.00
3	43.00 ÷44.50	10.00 ÷14.00
4	41.00 ÷43.50	11.00 ÷15.00
5	40.00 ÷42.00	14.00 ÷17.00
6	40.00 ÷41.50	16.00 ÷19.00
7	37.50 ÷40.50	15.50 ÷17.50
8	36.50 ÷38.50	12.00 ÷16.00
9	38.50 ÷41.50	8.00 ÷10.00
10	44.00 ÷46.00	6.50 ÷ 8.50
11	45.00 ÷46.50	7.50 ÷10.00
12	45.50 ÷47.00	9.50 ÷12.00
13	45.50 ÷47.00	11.50 ÷14.00

2.2. - POTENTIAL COEFFICIENTS

The Rapp 180 model, complete up to degree and order 180, has been used in all computations.

2.3. - SEASAT RADAR ALTIMETRY DATA

The Seasat satellite was launched in 1978 and it has been collecting data for three months. The Seasat contained a radar altimeter which continuously measured the distance from the satellite to the sea surface; the accuracy of the altimeter was approximately ±10 cm. From these data the geoid can be obtained directly if the orbit of the satellite and the oceanographic corrections are known. Oceanographic corrections consist of tides and both time-dependent and steady-state variations produced by currents.

The data from Seasat experiment have been processed by Rapp and Rowlands and one global network and four regional network adjustments were carried out (Rapp, 1981; Rowlands, 1981). One of these regions, the North Atlantic, included data from the Mediterranean Basin; in this area, after adjustment of the orbital parameters, the cross-over errors were ±26 cm (Cruz and Rapp, 1982). Cruz and Rapp compared the adjusted data from the Seasat and Geos-3 satellites in the Mediterranean and the comparison indicated the presence of a systematic difference and a slope between the two surfaces. A local adjustment of the Seasat data in this region was then carried out. Also, in this new adjustment, all tide values were set to zero because the Schwiderski correction is not valid in this area. The cross-over discrepancy of this adjustment is ±15 cm. The data set used in this work is this latest one (Cruz and Rapp, 1982).

It is worth mentioning that, in general, in the Mediterranean basin tide corrections are small except for the Adriatic Sea where they can be up to 1 m and more.

The Seasat geoid has been used, here, only for comparison purposes.

2.4. - Vertical deflections

Vertical deflection measurements have been supplied by IAG SSG 5.50, which we heartily thank. A total amount of 323 vertical deflection points where available, which have been used for comparison only.

3. — THE COVARIANCE FUNCTION

3.1. - Covariance function models

The choice of a priori covariance function or, switching to analitycal description of collocation, the choice of a proper approximation space is the central point when collocation is applied.

The construction of the maybe most famous covariance function models suitable for collocation has been treated by Tscherning and Rapp (1974) and by Tscherning (1976): the recommended model for the anomalous potential covariance function is:

$$C(P,Q) = \sum_{l=0}^{\infty} \frac{A}{(l-2)(l+24)} (R^2/r_P\, r_Q)^{l+1} P_l(\cos \psi_{P,Q}) \tag{3.1}$$

while all the other needed auto and cross-covariance functions are derived from this basic one.

When working in small areas the mentioned global covariance function must be replaced by a local one in order to avoid numerical instabilities. It has been found (Tscherning, 1976) that a reasonable model for a local covariance function can be expressed again by (3.1) where a certain number of coefficients of the first degrees is set to zero.

3.2. - COVARIANCE FUNCTIONS IN PRACTICE

The actual use of model (3.1) as local covariance function requires the estimation of three parameters, i.e. A, which is a scale parameter, the radius R, of the Bjerhammar sphere, and the order, n, of the local function, i.e. the number of terms to be deleted.

All the quantities must be set to proper values in order to obtain a good agreement between the model-covariance function and the «true» local-covariance function according to the main features.

The available gravity anomaly data have been used to estimate zone by zone 13 empirical covariance functions.

The great variety of geophysical situations we have in Italy is immediately evident by inspecting the shape and the power of the different functions.

The empirical covariance functions of zone 4 (Central Italy) and of zone 10 (Alpine Region) are represented in fig. 2 as an example of these differences. In table 2 are shown the values of the functions at the origin; the values of the noise variances and the positions of the first zero (ψ_0).

The great variety of values must be again remarked.

TABLE 2

MAIN PARAMETERS OF COVARIANCE FUNCTIONS

Zone	Δg signal variance ($mgal^2$)	Δg noise variance ($mgal^2$)	ψ_0	n
1	3662	202	30′	160
2	2930	15	40′	120
3	2214	191	50′	90
4	1234	27	50′	90
5	922	(—2)	32′	150
6	1052	121	30′	160
7	1781	204	22′	220
8	3142	25	37′	140
9	696	2	22′	220
10	3264	18	28′	160
11	3800	(—2)	37′	130
12	3209	5	25′	200
13	1758	11	31′	160

As it is expected from the many researches in this field (see for instance Sünkel, 1981), the local covariance functions perform a very typical behavior with high value at the origin and short correlation length in rough tectonically active areas (e.g. Alps and Sicily) and vice-versa in plain or settled areas.

The A parameter of expression (3.1) is internally computed by the program using the gravity anomaly signal variance. The local function degree is selected by fitting the first zero-point of the empirical covariance function; this can be done following Tscherning and Rapp (1974), because the higher is the order, the nearer to the origin is the first zero. The radius R has been held fixed to the value 0.9998 RE because it is not clear thoretically how could reasonably be glued solutions estimated by covariance functions referring to different domains of harmonicity.

The noise variance, which is estimated in this way together with the covariance function can happen to be negative: in this case we have always reset an arbitrary, small positive value (e.g. 1 $mgal^2$).

4. — PRACTICAL COMPUTATION MANAGEMENT

4.1. - SINGLE ZONES TREATMENT

As already explained, the first step of data treatment is the zone partitioning and then the estimation of a covariance function for each zone.

Mereover in some areas of particularly high data density, some of them have been neglected. This resulted in a decrease of the data budget to about 3000 values, with a much more regular density distribution.

The second step is just the estimation of geoidal heights in a regular grid with a 10′ mesh-side; moreover, the solution of normal equation is saved and can be used for further computations. In fact, if the normal equation solution is available, any potential-related quantity can be computed in a separate run taking advantage of the restarting capability of the program.

Seasat altimeter geoid and vertical deflections have actually been compared in this manner.

4.2. - THE ZONES PATCHING

The 13 regions into which we have partitioned Italy are as mentioned strongly overlapping; there are therefore a lot of grid point where the geoidal heights have been computed using two, or sometimes more, partially different sets of data. How to combine these different estimates in order to obtain the best unique estimate is not a practically solved problem, till now.

The main difficulty is to obtain a good estimate of the covariances between the heights of the common points, estimated from the different zones.

In the present case, the simple weighted average has been used as final estimate; this is by no means a rigorous solution but it becomes anyway meaningful if the discrepancies are small.

The mean square values of residuals are computed, too, and are used as a tool to decide whether the weighted averages are acceptable or some reasons for the discrepancies must be sought for.

4.3. - A REMARK ON LOCAL APPLICATIONS OF COLLOCATION

The principle on which the collocation is used in a local mode relies on the following heuristic reasoning: the information on the law frequency components of the gravity field comes from large averages of measured quantities (f.i. gravity anomalies) and cannot be influenced significantly from local observations. Whence a reliable high order reference field must be used in order to introduce this information. If the corresponding coefficients are fixed and considered as known up to a certain degree only higher frequency components must be estimated; correspondingly an «optimal» estimate can be obtained by using a covariance function where all the low frequencies have been cut off (2), what is in fact done as previously described to model the local features of the empirical covariance function. It follows from this reasoning that the degree of the reference fiald should always be larger than the low frequency component cut off in the local covariance function: this we remark to prevent other beginners, as we consider ourselves, from making the same errors that we made in a first step of computations of the Italian geoid.

5. — PRESENT RESULTS

5.1. - THE GRAVIMETRIC GEOID «ITALGEO 83»

As already mentioned, the geoidal heights have been computed on a regular grid with a 10′ mesh-side. The covered area is the whole Italian land and some smal marine regions, reteined only to simplify the data management.

The final result is tabulated in the appendix.

The geoidal height m.s.e.s estimated from collocation formulae are almost everywhere less than 0.5 m, with the exception of sea zones, i.e. zones far away from the data area.

In the overlapping zones we have also computed the m.s.e. of the weighted averages: their distribution is shown in table 3.

(2) This corresponds to a stepwis estimation of the components of T on two subspace of the Hilbert space admitting $C(P,Q)$ as a reproducing kernel: the two projectors on these subspaces coincide as a matter of fact with the low frequency and high frequency components of kernel $C(P,Q)$.

TABLE 3
DISTRIBUTION OF M.S.E. OF POINTS IN OVERLAPPING AREAS

σ — interval (m)	Number of points
0.00 ÷ 0.10	238
0.10 ÷ 0.20	141
0.20 ÷ 0.30	69
0.30 ÷ 0.40	66
0.40 ÷ 0.50	36
0.50 ÷ 0.60	20
0.60 ÷ 0.70	14
0.70 ÷ 0.80	8
0.80 ÷ 0.90	4
0.90 ÷ 1.00	1
> 1.00	7

This should not be taken as an overall measure of the accuracy of the estimates, but more as an internal consistency of the method.

In any way it is not by chance that 47 of the 54 m.s. weighted residuals greater than 0.50 m, were located at a latitude higher than 45°30′, i.e. in the immediate sorroundings of the Alps.

5.2. - A FIRST COMPARISON WITH AN ASTROGEODETIC GEOID

The Italgeo 83 has been first of all compared with a geoid derived, also by collocation, from astrogeodetic data.

This has been computed by C.C. Tscherning in '82 and communicated to the authors in private form. It consists of about a hundred of estimated ondulations spaced half degree by half degree from latitude 43° to 47°; 74 of them are in common with our predicted values.

The average of the discrepancies between the two and their mean square error are respectively

$$\bar{\Delta} = 0.82 \text{ m}$$
$$S_\Delta = 1.36 \text{ m}$$

This seems for the moment acceptable considering that the two geoids have been computed from completely independent data sets and no local optimization of the datum shift has been used to transform the vertical deflections from the ED50 to the GRS80 system.

5.3. - Comparison between gravimetric and astrogeodetic deflections

From Italgeo 83, deflections of the vertical have been predicted at the same points where we had astrogeodetic measurements, for comparison purposes.

The results are summarized in table 4 in form of histograms of the discrepancies

$$\delta\xi = \xi_{observed} - \xi_{predicted}$$

$$\delta\eta = \eta_{observed} - \eta_{predicted}$$

The gravimetric deflections are firstly predicted in the GRS80 system and then transformed to the ED50 system.

The columns of table 4 refer to classes of amplitude of one second and are centered at the heading value. The column «outside» refers to discrepancies which are larger than 10″.5 in absolute value.

Though these results are not exiting, one point is absolutely clear: the largest discrepancies between gravimetric and observed deflections happen in areas where the topography is extremely rough, like 10, 11, 12, 13, which refer to the alpine arc, or to tectonically active areas like zone 5, which includes the very strongly seismic region Irpinia or zone 7 with the seismic area of the Straits of Messina.

A reason for the relatively high values of the discrepancies, should be sought for in the lack of any correction for the topography, which on the other hand is known to have a large influence on the deflections ξ, η. Moreover, the gravimetric deflections have been for the moment predicted only at the mean sea level, since we were not aware of the height of the measuring points: this might give a significant difference, specially in montaneous areas.

Furthermore the mean density of gravimetric points is not very high, thus it makes no wonder that only poor predictions can be made, where the gravity field shows a rough pattern.

5.4. - Comparison between Italgeo 83 and altimetry derived geoid

As we said previously a set of Seasat altimetry data adjustment bt Cruz and Rapp (cfr. Cruz and Rapp 1982) has been compared to the Italgeo 83 ondulations.

To this aim only points close to the Italian shores have used so that the collocation solution could give a really informative prediction there (i.e., with a prediction error of about 0.50-0.70 m). It is worth noting that being both geoids referred to the GRS80 system, no datum shift has been applied before comparing one to the other.

TABLE 4

Zone N.		—10	—9	—8	—7	—6	—5	—4	—3	—2	—1	0	1	2	3	4	5	6	7	8	9	10	Outside	$\overline{\delta\xi}$ $\overline{\delta\eta}$	$S_\xi S_\eta$
1	δξ	0	1	0	1	0	0	1	2	5	3	4	2	1	0	0	1	0	0	0	0	0	2	—2.5	4.3
	δη	2	0	0	1	1	0	1	1	3	3	7	1	2	1	0	0	0	0	0	0	0	0	—1.7	3.4
2	δξ	0	1	0	1	3	1	5	3	4	4	4	2	2	1	1	0	0	0	0	0	0	4	—2.6	5.7
	δη	0	0	1	0	1	1	1	2	0	0	4	9	3	6	2	1	2	0	2	1	0	0	1.5	3.7
3	δξ	0	0	1	0	1	4	2	0	3	3	2	2	0	0	0	0	0	0	0	0	0	1	—3.2	3.1
	δη	0	0	0	0	1	0	0	3	2	3	3	0	3	2	1	1	0	0	0	0	0	0	0.0	2.8
4	δξ	0	0	1	0	0	0	2	1	3	2	5	1	3	0	1	1	0	0	1	0	0	1	0.5	4.5
	δη	0	1	0	1	0	0	2	1	2	4	1	2	3	0	2	1	2	0	0	0	0	0	0.0	3.9
5	δξ	2	0	0	0	0	0	0	0	0	2	1	4	2	1	0	1	1	0	1	2	1	11	1.8	10.6
	δη	0	0	1	2	2	0	0	0	2	0	1	0	0	0	2	1	2	5	1	3	4	3	4.7	6.4
6	δξ	0	0	0	0	1	0	0	0	0	2	3	1	0	8	0	0	0	0	1	0	0	0	1.6	2.9
	δη	0	0	0	0	0	0	0	0	1	1	0	3	3	1	3	2	2	0	0	0	0	0	2.6	2.4
7	δξ	0	0	0	0	0	0	0	0	0	2	0	3	0	3	3	1	0	1	1	1	0	10	0.7	9.8
	δη	1	1	0	1	0	1	0	0	0	2	1	0	0	0	0	1	1	0	0	2	1	13	6.1	8.9
8	δξ	0	0	0	0	0	0	0	0	2	1	8	6	7	3	5	3	1	3	2	1	2	1	3.1	3.3
	δη	0	0	0	1	0	0	1	2	4	6	2	4	6	5	1	2	3	3	2	0	0	3	1.4	5.3
9	δξ	1	1	0	0	1	0	2	3	2	2	2	0	1	4	2	4	2	2	0	0	0	2	—0.2	5.6
	δη	0	3	3	0	2	2	2	1	2	3	1	0	0	0	1	1	2	1	0	2	2	3	—0.4	7.1
10	δξ	2	1	0	1	0	2	0	0	0	1	3	1	1	3	0	0	0	2	2	0	0	8	—1.4	9.7
	δη	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	2	1	0	1	1	18	1.0	20.7
11	δξ	1	0	2	3	1	1	2	0	0	1	0	0	1	0	0	0	0	0	0	0	0	5	—8.7	6.2
	δη	0	0	1	0	1	0	0	0	1	5	0	4	2	0	0	1	0	1	0	0	0	1	0.6	4.5
12	δξ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	—6.0	52.7
	δη	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	19.2	22.8
13	δξ	0	3	1	2	1	3	0	0	1	0	1	0	0	0	1	1	0	0	0	0	0	18	—8.6	7.0
	δη	0	0	0	0	0	0	0	3	1	0	1	1	2	4	2	5	2	3	2	2	3	1	4.6	4.2

A total of 175 points has been processed and the differences $N_{altimetry}$ — $N_{gravimetry}$ have been computed: the resulting overall average and the mean square value are

$\bar{\Delta}$ = — 1.06 m

S_{Δ} = 1.56 m

As we expected, also according to the remarks in Cruz and Rapp (1982), the mean square error of the differences is significantly too high to be explained as the sum of the prediction error from the land gravity determined geoid and the estimation error of the adjustment altimetric ondulations.

For this reason we have tried a comparison in a regional mode partitioning the Italian coast as shown in fig. 3.

On the figure for each zone are indicated the number N of points processed, the zone average difference $\bar{\Delta}$, and the zone mean square error S_{Δ}.

Apart from minor oxillations, some general remarks can be drawn:

— the mean square errors are compatible with the expected theoretical values;

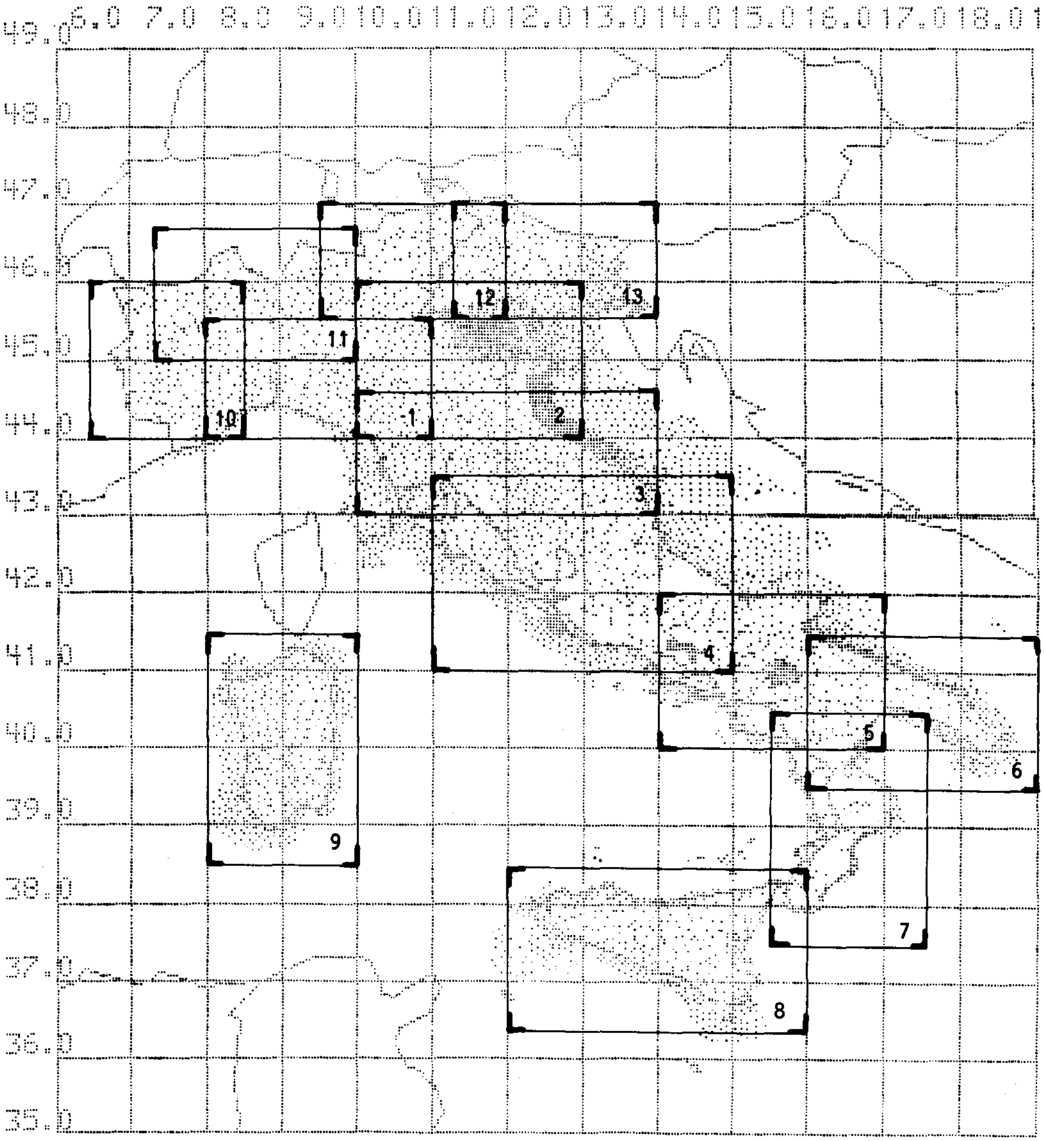
— the mean zone values show a clear systematic pattern with an increasing difference from north to south seas;

— the — 3.08 m difference ($N_{alt.}$ — N_{grav}) in the Southern Adriatic Sea is in quite reasonable agreement with the analogous — 3.70 m found in comparing the Seasat geoid with the Greek gravimetric geoid DGGG80 (cfr. Cruz and Rapp, 1982).

6. — FINAL COMMENTS AND INDICATIONS

Considering the work done till now we can say that the first steps in the direction of the production of a high accuracy geoid in Italy and sorrounding areas have been done: in particular a team of researchers has begun to be trained in such geodetic computations. A first gravimetric geoid to which we can assign a prediction error smaller than 0.50 m in not too rough areas has been completed. Future work will be done to enlarge the data base used and to improve the collocation method by implementing estimates of the effects of topographic masses (cfr. for instance, H. Sünkel, 1981): to this aim we mention that a large data set of gravity values as well as of mean topographic heights is becoming available (M.T. Carrozzo et al., 1981a-1981b).

A further deeper analysis of the biases of altimetric computed geoid is also deserved, with particular care to the local tidal models.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48.0
47.0
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44.0
43.0
42.0
41.0
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39.0
38.0
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Fig. 1

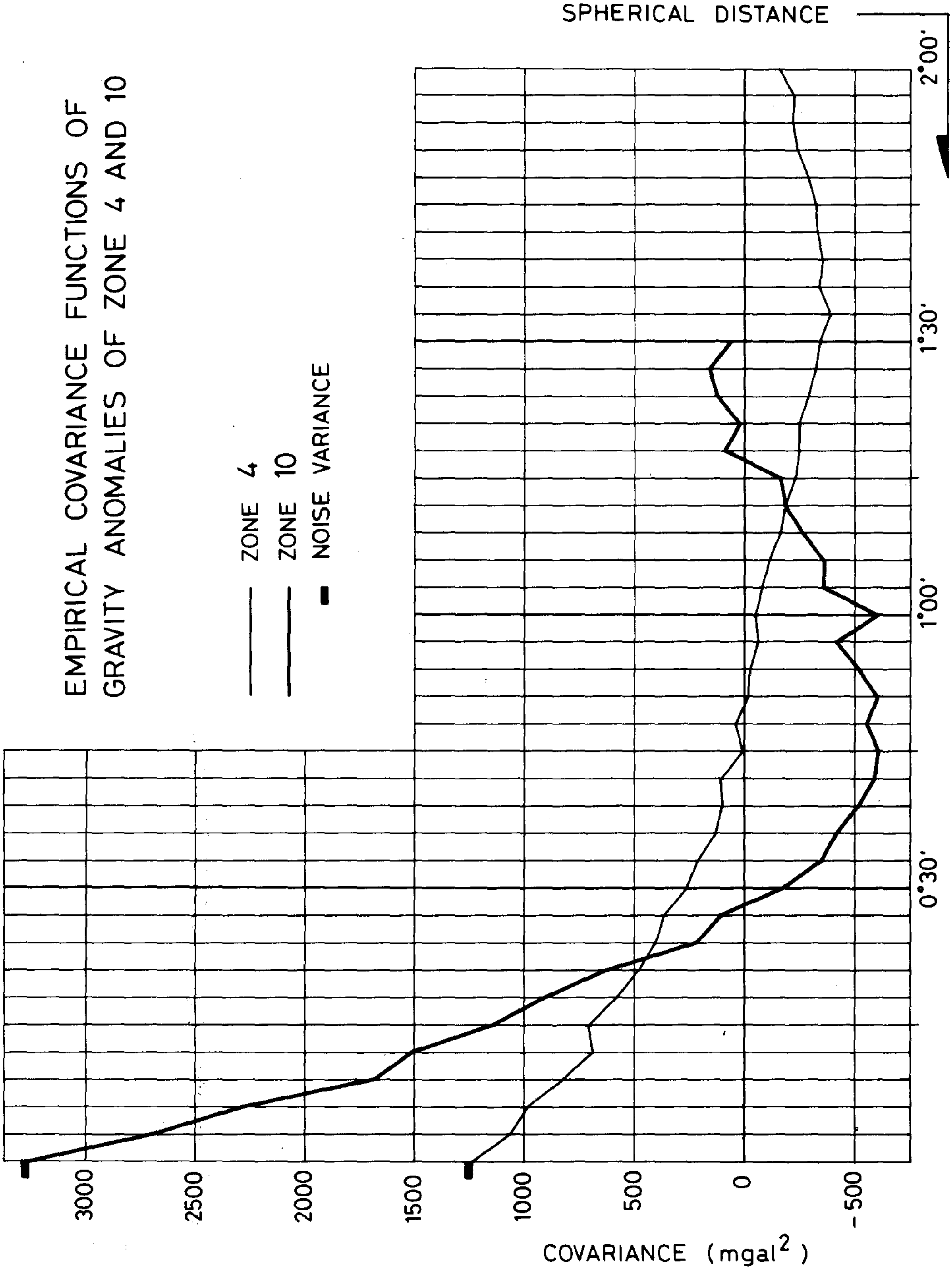
EMPIRICAL COVARIANCE FUNCTIONS OF
GRAVITY ANOMALIES OF ZONE 4 AND 10
ZONE 4
ZONE 10
NOISE VARIANCE
SPHERICAL DISTANCE
0°30'
1°00'
1°30'
2°00'
3000
2500
2000
1500
1000
500
0
-500
COVARIANCE (mgal²)

Fig. 2

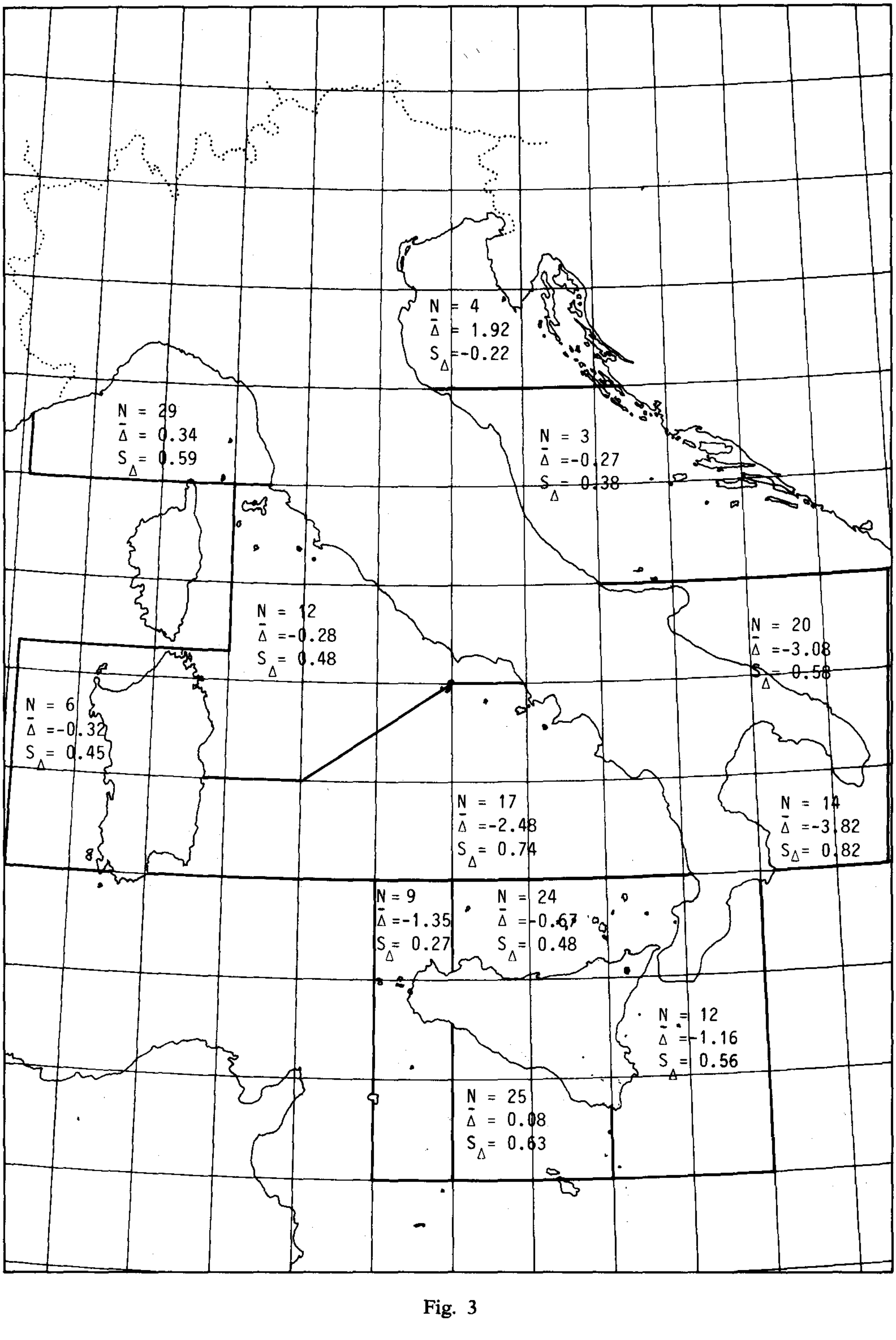
N = 4
Δ = 1.92
S_Δ =-0.22
N = 29
Δ = 0.34
S_Δ = 0.59
N = 3
Δ =-0.27
S_Δ = 0.38
N = 12
Δ =-0.28
S_Δ = 0.48
N = 20
Δ =-3.08
S_Δ = 0.58
N = 6
Δ =-0.32
S_Δ = 0.45
N = 17
Δ =-2.48
S_Δ = 0.74
N = 14
Δ =-3.82
S_Δ = 0.82
N = 9
Δ =-1.35
S_Δ = 0.27
N = 24
Δ =-0.67
S_Δ = 0.48
N = 12
Δ =-1.16
S_Δ = 0.56
N = 25
Δ = 0.08
S_Δ = 0.63

Fig. 3

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APPENDIX

THE NUMERICAL REPRESENTATION OF ITALGEO 83

LAT. D M	LON. D M	GEOID M	LAT. D M	LON. D M	GEOID M	LAT. D M	LON. D M	GEOID M
47	9 30	49.67	47	9 40	50.60	47	9 50	51.34
47	10	51.84	47	10 10	52.10	47	10 20	52.13
47	10 30	51.99	47	10 40	51.74	47	10 50	51.17
47	11	50.35	47	11 10	49.98	47	11 20	49.49
47	11 30	47.94	47	11 40	47.73	47	11 50	47.83
47	12	48.10	47	12 10	48.41	47	12 20	49.13
47	12 30	49.69	47	12 40	50.05	47	12 50	50.21
47	13	50.19	47	13 10	50.04	47	13 20	49.78
47	13 30	49.45	47	13 40	49.07	47	13 50	48.64
47	14	48.19	46 50	9 30	51.09	46 50	9 40	51.77
46 50	9 50	51.98	46 50	10	51.67	46 50	10 10	51.12
46 50	10 20	50.58	46 50	10 30	49.70	46 50	10 40	49.57
46 50	10 50	49.18	46 50	11	48.54	46 50	11 10	47.80
46 50	11 20	47.86	46 50	11 30	46.86	46 50	11 40	46.58
46 50	11 50	46.96	46 50	12	47.25	46 50	12 10	47.61
46 50	12 20	48.35	46 50	12 30	48.95	46 50	12 40	49.35
46 50	12 50	49.51	46 50	13	49.51	46 50	13 10	49.41
46 50	13 20	49.25	46 50	13 30	49.05	46 50	13 40	48.80
46 50	13 50	48.51	46 50	14	48.15	46 40	9 30	51.70
46 40	9 40	52.05	46 40	9 50	51.72	46 40	10	50.46
46 40	10 10	48.83	46 40	10 20	48.80	46 40	10 30	47.99
46 40	10 40	47.21	46 40	10 50	46.76	46 40	11	46.35
46 40	11 10	46.11	46 40	11 20	46.50	46 40	11 30	46.52
46 40	11 40	46.74	46 40	11 50	47.37	46 40	12	47.63
46 40	12 10	47.43	46 40	12 20	47.52	46 40	12 30	47.78
46 40	12 40	48.05	46 40	12 50	48.05	46 40	13	47.99
46 40	13 10	47.96	46 40	13 20	47.96	46 40	13 30	47.97
46 40	13 40	47.98	46 40	13 50	47.94	46 40	14	47.78
46 30	7 30	52.41	46 30	7 40	51.96	46 30	7 50	51.35
46 30	8	50.63	46 30	8 10	49.95	46 30	8 20	49.49
46 30	8 30	49.26	46 30	8 40	49.10	46 30	8 50	48.89
46 30	9	48.57	46 30	9 10	48.21	46 30	9 20	47.92
46 30	9 30	49.58	46 30	9 40	49.97	46 30	9 50	50.00
46 30	10	49.54	46 30	10 10	48.58	46 30	10 20	47.72
46 30	10 30	47.84	46 30	10 40	47.14	46 30	10 50	46.67
46 30	11	46.24	46 30	11 10	45.89	46 30	11 20	45.98
46 30	11 30	46.64	46 30	11 40	47.48	46 30	11 50	48.05
46 30	12	47.83	46 30	12 10	46.99	46 30	12 20	46.67
46 30	12 30	46.60	46 30	12 40	46.54	46 30	12 50	46.21
46 30	13	46.02	46 30	13 10	46.05	46 30	13 20	46.24
46 30	13 30	46.55	46 30	13 40	46.89	46 30	13 50	47.18
46 30	14	47.23	46 20	7 30	52.40	46 20	7 40	51.74
46 20	7 50	50.82	46 20	8	49.71	46 20	8 10	48.61
46 20	8 20	47.87	46 20	8 30	47.97	46 20	8 40	48.06
46 20	8 50	47.82	46 20	9	47.34	46 20	9 10	46.60
46 20	9 20	45.72	46 20	9 30	46.84	46 20	9 40	47.68
46 20	9 50	47.85	46 20	10	47.76	46 20	10 10	47.08
46 20	10 20	46.56	46 20	10 30	46.92	46 20	10 40	46.71
46 20	10 50	46.28	46 20	11	45.84	46 20	11 10	45.62
46 20	11 20	46.03	46 20	11 30	47.34	46 20	11 40	47.82
46 20	11 50	47.98	46 20	12	46.86	46 20	12 10	46.25
46 20	12 20	45.85	46 20	12 30	45.74	46 20	12 40	45.41
46 20	12 50	45.03	46 20	13	44.80	46 20	13 10	44.84
46 20	13 20	45.24	46 20	13 30	45.69	46 20	13 40	46.16
46 20	13 50	46.50	46 20	14	46.64	46 10	7 30	52.26
46 10	7 40	51.45	46 10	7 50	50.35	46 10	8	49.02
46 10	8 10	47.73	46 10	8 20	47.37	46 10	8 30	47.69
46 10	8 40	47.36	46 10	8 50	46.80	46 10	9	46.30

46 10	9 10	45.62	46 10	9 20	44.80	46 10	9 30	45.43
46 10	9 40	45.86	46 10	9 50	45.92	46 10	10	45.99
46 10	10 10	46.28	46 10	10 20	46.27	46 10	10 30	46.79
46 10	10 40	46.78	46 10	10 50	46.50	46 10	11	45.91
46 10	11 10	45.79	46 10	11 20	46.70	46 10	11 30	47.61
46 10	11 40	47.97	46 10	11 50	47.37	46 10	12	46.58
46 10	12 10	45.45	46 10	12 20	45.07	46 10	12 30	44.66
46 10	12 40	44.23	46 10	12 50	43.92	46 10	13	43.82
46 10	13 10	43.99	46 10	13 20	44.39	46 10	13 30	44.85
46 10	13 40	45.37	46 10	13 50	45.80	46 10	14	46.04
46	6 30	52.94	46	6 40	53.29	46	6 50	53.36
46	7	53.30	46	7 10	53.12	46	7 20	52.70
46	7 30	52.19	46	7 40	51.61	46	7 50	50.68
46	8	49.64	46	8 10	48.78	46	8 20	48.25
46	8 30	47.66	46	8 40	46.48	46	8 50	45.79
46	9	45.42	46	9 10	44.99	46	9 20	44.63
46	9 30	45.53	46	9 40	45.89	46	9 50	46.02
46	10	45.85	46	10 10	46.35	46	10 20	46.47
46	10 30	47.05	46	10 40	46.68	46	10 50	46.12
46	11	45.87	46	11 10	46.31	46	11 20	46.97
46	11 30	47.59	46	11 40	47.48	46	11 50	46.60
46	12	45.84	46	12 10	44.96	46	12 20	44.30
46	12 30	43.79	46	12 40	43.49	46	12 50	43.37
46	13	43.38	46	13 10	43.49	46	13 20	43.78
46	13 30	44.14	46	13 40	44.63	46	13 50	45.16
46	14	45.49	45 50	6 30	53.71	45 50	6 40	53.69
45 50	6 50	53.08	45 50	7	52.10	45 50	7 10	51.54
45 50	7 20	50.70	45 50	7 30	50.44	45 50	7 40	50.25
45 50	7 50	50.03	45 50	8	49.51	45 50	8 10	49.05
45 50	8 20	48.12	45 50	8 30	46.68	45 50	8 40	45.57
45 50	8 50	45.03	45 50	9	44.50	45 50	9 10	44.19
45 50	9 20	44.08	45 50	9 30	44.78	45 50	9 40	45.07
45 50	9 50	45.27	45 50	10	45.18	45 50	10 10	45.43
45 50	10 20	46.10	45 50	10 30	46.24	45 50	10 40	46.13
45 50	10 50	45.90	45 50	11	46.18	45 50	11 10	47.01
45 50	11 20	47.44	45 50	11 30	47.45	45 50	11 40	46.84
45 50	11 50	45.81	45 50	12	44.95	45 50	12 10	44.24
45 50	12 20	43.74	45 50	12 30	43.38	45 50	12 40	43.25
45 50	12 50	43.22	45 50	13	43.28	45 50	13 10	43.40
45 50	13 20	43.66	45 50	13 30	43.93	45 50	13 40	44.31
45 50	13 50	44.75	45 50	14	45.08	45 40	6 30	54.54
45 40	6 40	54.36	45 40	6 50	53.56	45 40	7	52.05
45 40	7 10	50.73	45 40	7 20	50.04	45 40	7 30	49.85
45 40	7 40	49.34	45 40	7 50	49.16	45 40	8	48.89
45 40	8 10	48.11	45 40	8 20	46.82	45 40	8 30	45.66
45 40	8 40	44.41	45 40	8 50	43.82	45 40	9	43.46
45 40	9 10	43.27	45 40	9 20	43.24	45 40	9 30	43.52
45 40	9 40	43.84	45 40	9 50	44.21	45 40	10	44.49
45 40	10 10	44.78	45 40	10 20	45.21	45 40	10 30	45.40
45 40	10 40	45.43	45 40	10 50	45.69	45 40	11	46.51
45 40	11 10	46.59	45 40	11 20	46.27	45 40	11 30	45.96
45 40	11 40	45.36	45 40	11 50	44.72	45 40	12	44.27
45 40	12 10	43.81	45 40	12 20	43.51	45 40	12 30	43.37
45 40	12 40	43.34	45 40	12 50	43.44	45 40	13	43.61
45 40	13 10	43.80	45 40	13 20	43.99	45 40	13 30	44.16
45 40	13 40	44.33	45 40	13 50	44.55	45 40	14	44.87
45 30	6 30	55.23	45 30	6 40	54.96	45 30	6 50	54.18
45 30	7	52.96	45 30	7 10	51.58	45 30	7 20	50.36
45 30	7 30	50.11	45 30	7 40	49.82	45 30	7 50	49.06
45 30	8	48.07	45 30	8 10	46.62	45 30	8 20	45.43
45 30	8 30	44.51	45 30	8 40	43.45	45 30	8 50	42.90

45 30	9	42.51	45 30	9 10	42.22	45 30	9 20	41.99
45 30	9 30	42.02	45 30	9 40	42.22	45 30	9 50	42.61
45 30	10	42.92	45 30	10 10	43.30	45 30	10 20	43.72
45 30	10 30	43.97	45 30	10 40	44.47	45 30	10 50	44.71
45 30	11	45.12	45 30	11 10	45.30	45 30	11 20	45.27
45 30	11 30	45.01	45 30	11 40	44.52	45 30	11 50	44.12
45 30	12	43.78	45 30	12 10	43.51	45 30	12 20	43.40
45 30	12 30	43.44	45 30	12 40	43.58	45 30	12 50	43.79
45 30	13	44.06	45 30	13 10	44.41	45 30	13 20	44.56
45 30	13 30	44.66	45 30	13 40	44.71	45 30	13 50	44.80
45 30	14	44.94	45 20	6 30	55.45	45 20	6 40	54.94
45 20	6 50	54.05	45 20	7	52.94	45 20	7 10	51.75
45 20	7 20	50.63	45 20	7 30	50.18	45 20	7 40	49.52
45 20	7 50	48.23	45 20	8	46.69	45 20	8 10	45.32
45 20	8 20	44.25	45 20	8 30	43.44	45 20	8 40	42.53
45 20	8 50	42.07	45 20	9	41.66	45 20	9 10	41.29
45 20	9 20	40.92	45 20	9 30	40.64	45 20	9 40	40.53
45 20	9 50	40.56	45 20	10	40.66	45 20	10 10	40.80
45 20	10 20	41.26	45 20	10 30	41.76	45 20	10 40	42.30
45 20	10 50	42.75	45 20	11	43.11	45 20	11 10	43.45
45 20	11 20	43.71	45 20	11 30	43.88	45 20	11 40	43.89
45 20	11 50	43.70	45 20	12	43.41	45 20	12 10	43.23
45 20	12 20	43.18	45 20	12 30	43.22	45 20	12 40	43.34
45 20	12 50	43.52	45 20	13	43.75	45 10	6 30	55.26
45 10	6 40	54.19	45 10	6 50	52.94	45 10	7	51.74
45 10	7 10	50.96	45 10	7 20	50.51	45 10	7 30	50.01
45 10	7 40	48.68	45 10	7 50	47.21	45 10	8	45.89
45 10	8 10	44.61	45 10	8 20	43.54	45 10	8 30	42.64
45 10	8 40	41.83	45 10	8 50	41.38	45 10	9	40.96
45 10	9 10	40.56	45 10	9 20	40.18	45 10	9 30	39.82
45 10	9 40	39.55	45 10	9 50	39.41	45 10	10	39.34
45 10	10 10	39.36	45 10	10 20	39.68	45 10	10 30	40.11
45 10	10 40	40.56	45 10	10 50	41.03	45 10	11	41.55
45 10	11 10	42.05	45 10	11 20	42.51	45 10	11 30	42.90
45 10	11 40	43.16	45 10	11 50	43.17	45 10	12	43.00
45 10	12 10	42.88	45 10	12 20	42.89	45 10	12 30	42.97
45 10	12 40	43.12	45 10	12 50	43.34	45 10	13	43.60
45	6 30	55.40	45	6 40	54.09	45	6 50	52.92
45	7	52.00	45	7 10	50.96	45	7 20	50.44
45	7 30	49.68	45	7 40	48.29	45	7 50	46.82
45	8	45.72	45	8 10	44.42	45	8 20	43.43
45	8 30	42.48	45	8 40	41.52	45	8 50	41.04
45	9	40.67	45	9 10	40.40	45	9 20	40.07
45	9 30	39.54	45	9 40	39.12	45	9 50	38.86
45	10	38.75	45	10 10	38.46	45	10 20	38.56
45	10 30	38.83	45	10 40	39.21	45	10 50	39.72
45	11	40.29	45	11 10	40.88	45	11 20	41.45
45	11 30	41.91	45	11 40	42.22	45	11 50	42.33
45	12	42.30	45	12 10	42.29	45	12 20	42.36
45	12 30	42.49	45	12 40	42.71	45	12 50	42.99
45	13	43.31	44 50	6 30	56.14	44 50	6 40	55.30
44 50	6 50	54.22	44 50	7	52.84	44 50	7 10	51.44
44 50	7 20	50.60	44 50	7 30	49.32	44 50	7 40	47.90
44 50	7 50	46.64	44 50	8	45.58	44 50	8 10	44.62
44 50	8 20	43.71	44 50	8 30	42.80	44 50	8 40	42.01
44 50	8 50	41.65	44 50	9	41.53	44 50	9 10	41.33
44 50	9 20	40.96	44 50	9 30	40.35	44 50	9 40	39.87
44 50	9 50	39.31	44 50	10	38.79	44 50	10 10	38.40
44 50	10 20	38.19	44 50	10 30	38.20	44 50	10 40	38.42
44 50	10 50	38.85	44 50	11	39.33	44 50	11 10	39.88
44 50	11 20	40.44	44 50	11 30	40.96	44 50	11 40	41.31

44 50	11 50	41.46	44 50	12	41.49	44 50	12 10	41.52
44 50	12 20	41.63	44 50	12 30	41.84	44 50	12 40	42.15
44 50	12 50	42.51	44 50	13	42.91	44 40	6 30	56.60
44 40	6 40	55.98	44 40	6 50	54.89	44 40	7	53.53
44 40	7 10	52.35	44 40	7 20	51.12	44 40	7 30	49.81
44 40	7 40	48.29	44 40	7 50	47.09	44 40	8	46.36
44 40	8 10	45.75	44 40	8 20	45.00	44 40	8 30	44.34
44 40	8 40	43.82	44 40	8 50	43.44	44 40	9	43.15
44 40	9 10	43.13	44 40	9 20	42.63	44 40	9 30	42.17
44 40	9 40	41.51	44 40	9 50	40.75	44 40	10	39.84
44 40	10 10	39.23	44 40	10 20	38.76	44 40	10 30	38.51
44 40	10 40	38.42	44 40	10 50	38.48	44 40	11	38.68
44 40	11 10	39.00	44 40	11 20	39.45	44 40	11 30	39.93
44 40	11 40	40.29	44 40	11 50	40.55	44 40	12	40.68
44 40	12 10	40.69	44 40	12 20	40.84	44 40	12 30	41.15
44 40	12 40	41.55	44 40	12 50	42.00	44 40	13	42.47
44 30	6 30	56.47	44 30	6 40	55.92	44 30	6 50	54.72
44 30	7	53.14	44 30	7 10	52.19	44 30	7 20	51.48
44 30	7 30	50.41	44 30	7 40	49.12	44 30	7 50	48.08
44 30	8	47.65	44 30	8 10	47.10	44 30	8 20	46.56
44 30	8 30	46.27	44 30	8 40	45.78	44 30	8 50	45.16
44 30	9	44.89	44 30	9 10	44.64	44 30	9 20	44.45
44 30	9 30	44.02	44 30	9 40	43.27	44 30	9 50	42.47
44 30	10	41.95	44 30	10 10	41.13	44 30	10 20	40.43
44 30	10 30	40.05	44 30	10 40	39.59	44 30	10 50	39.41
44 30	11	39.26	44 30	11 10	39.12	44 30	11 20	39.17
44 30	11 30	39.31	44 30	11 40	39.45	44 30	11 50	39.55
44 30	12	39.69	44 30	12 10	39.73	44 30	12 20	39.87
44 30	12 30	40.14	44 30	12 40	40.58	44 30	12 50	41.11
44 30	13	41.68	44 30	13 10	41.85	44 30	13 20	42.50
44 30	13 30	43.13	44 30	13 40	43.70	44 30	13 50	44.20
44 30	14	44.63	44 20	6 30	55.93	44 20	6 40	55.54
44 20	6 50	54.58	44 20	7	53.26	44 20	7 10	52.15
44 20	7 20	51.55	44 20	7 30	50.88	44 20	7 40	50.10
44 20	7 50	49.40	44 20	8	48.76	44 20	8 10	48.35
44 20	8 20	47.83	44 20	8 30	47.21	44 20	8 40	46.63
44 20	8 50	46.21	44 20	9	45.92	44 20	9 10	45.65
44 20	9 20	45.33	44 20	9 30	45.11	44 20	9 40	44.69
44 20	9 50	44.20	44 20	10	43.63	44 20	10 10	43.30
44 20	10 20	42.81	44 20	10 30	42.29	44 20	10 40	41.79
44 20	10 50	41.33	44 20	11	40.88	44 20	11 10	40.25
44 20	11 20	40.12	44 20	11 30	39.89	44 20	11 40	39.66
44 20	11 50	39.48	44 20	12	39.41	44 20	12 10	39.45
44 20	12 20	39.63	44 20	12 30	39.94	44 20	12 40	40.40
44 20	12 50	40.93	44 20	13	41.49	44 20	13 10	41.70
44 20	13 20	42.33	44 20	13 30	42.93	44 20	13 40	43.49
44 20	13 50	43.98	44 20	14	44.41	44 10	6 30	55.11
44 10	6 40	54.97	44 10	6 50	54.43	44 10	7	53.59
44 10	7 10	52.74	44 10	7 20	52.07	44 10	7 30	51.62
44 10	7 40	51.04	44 10	7 50	50.29	44 10	8	49.45
44 10	8 10	48.89	44 10	8 20	48.22	44 10	8 30	47.74
44 10	8 40	47.27	44 10	8 50	46.98	44 10	9	46.75
44 10	9 10	46.54	44 10	9 20	46.34	44 10	9 30	46.12
44 10	9 40	45.81	44 10	9 50	45.48	44 10	10	45.01
44 10	10 10	44.71	44 10	10 20	44.46	44 10	10 30	44.28
44 10	10 40	43.87	44 10	10 50	43.39	44 10	11	42.71
44 10	11 10	42.29	44 10	11 20	41.99	44 10	11 30	41.49
44 10	11 40	40.97	44 10	11 50	40.51	44 10	12	40.14
44 10	12 10	40.07	44 10	12 20	40.10	44 10	12 30	40.26
44 10	12 40	40.59	44 10	12 50	41.02	44 10	13	41.51
44 10	13 10	41.70	44 10	13 20	42.26	44 10	13 30	42.80

44 10	13 40	43.31	44 10	13 50	43.77	44 10	14	44.16
44	6 30	54.03	44	6 40	54.09	44	6 50	53.91
44	7	53.52	44	7 10	53.03	44	7 20	52.53
44	7 30	52.02	44	7 40	51.38	44	7 50	50.53
44	8	49.50	44	8 10	48.90	44	8 20	48.40
44	8 30	47.97	44	8 40	47.62	44	8 50	47.45
44	9	47.31	44	9 10	47.21	44	9 20	47.09
44	9 30	46.94	44	9 40	46.75	44	9 50	46.51
44	10	46.00	44	10 10	45.84	44	10 20	45.56
44	10 30	45.12	44	10 40	44.88	44	10 50	44.74
44	11	44.23	44	11 10	43.85	44	11 20	43.48
44	11 30	43.07	44	11 40	42.63	44	11 50	42.06
44	12	41.51	44	12 10	41.20	44	12 20	41.10
44	12 30	41.00	44	12 40	41.13	44	12 50	41.38
44	13	41.73	44	13 10	41.84	44	13 20	42.30
44	13 30	42.76	44	13 40	43.20	44	13 50	43.59
44	14	43.92	43 50	10	46.54	43 50	10 10	46.37
43 50	10 20	46.26	43 50	10 30	46.16	43 50	10 40	45.89
43 50	10 50	45.61	43 50	11	45.41	43 50	11 10	45.12
43 50	11 20	44.89	43 50	11 30	44.55	43 50	11 40	44.53
43 50	11 50	43.98	43 50	12	43.32	43 50	12 10	42.77
43 50	12 20	42.45	43 50	12 30	42.13	43 50	12 40	42.01
43 50	12 50	41.97	43 50	13	41.95	43 50	13 10	42.13
43 50	13 20	42.46	43 50	13 30	42.84	43 50	13 40	43.19
43 50	13 50	43.48	43 50	14	43.73	43 40	10	47.33
43 40	10 10	47.20	43 40	10 20	47.11	43 40	10 30	47.11
43 40	10 40	46.99	43 40	10 50	46.78	43 40	11	46.59
43 40	11 10	46.49	43 40	11 20	46.28	43 40	11 30	45.86
43 40	11 40	45.67	43 40	11 50	45.33	43 40	12	44.99
43 40	12 10	44.44	43 40	12 20	43.93	43 40	12 30	43.47
43 40	12 40	43.21	43 40	12 50	43.00	43 40	13	42.70
43 40	13 10	42.63	43 40	13 20	42.82	43 40	13 30	43.11
43 40	13 40	43.32	43 40	13 50	43.48	43 40	14	43.62
43 30	10	48.06	43 30	10 10	48.01	43 30	10 20	47.97
43 30	10 30	47.96	43 30	10 40	47.99	43 30	10 50	47.90
43 30	11	47.90	43 30	11 10	47.79	43 30	11 20	47.63
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43 30	12	46.17	43 30	12 10	45.80	43 30	12 20	45.48
43 30	12 30	45.04	43 30	12 40	44.64	43 30	12 50	44.29
43 30	13	43.95	43 30	13 10	43.75	43 30	13 20	43.73
43 30	13 30	43.79	43 30	13 40	43.85	43 30	13 50	43.88
43 30	14	43.93	43 30	14 10	44.15	43 30	14 20	44.25
43 30	14 30	44.41	43 30	14 40	44.61	43 30	14 50	44.86
43 30	15	45.15	43 20	10	48.62	43 20	10 10	48.63
43 20	10 20	48.59	43 20	10 30	48.47	43 20	10 40	48.52
43 20	10 50	48.63	43 20	11	48.73	43 20	11 10	48.63
43 20	11 20	48.37	43 20	11 30	48.06	43 20	11 40	47.74
43 20	11 50	47.47	43 20	12	47.28	43 20	12 10	46.99
43 20	12 20	46.62	43 20	12 30	46.26	43 20	12 40	45.83
43 20	12 50	45.39	43 20	13	44.97	43 20	13 10	44.71
43 20	13 20	44.35	43 20	13 30	44.06	43 20	13 40	43.93
43 20	13 50	43.88	43 20	14	43.85	43 20	14 10	43.99
43 20	14 20	44.10	43 20	14 30	44.28	43 20	14 40	44.52
43 20	14 50	44.81	43 20	15	45.15	43 10	10	49.00
43 10	10 10	49.04	43 10	10 20	49.04	43 10	10 30	49.04
43 10	10 40	49.22	43 10	10 50	49.40	43 10	11	49.31
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43 10	11 40	48.44	43 10	11 50	48.20	43 10	12	48.03
43 10	12 10	47.84	43 10	12 20	47.58	43 10	12 30	47.20
43 10	12 40	46.81	43 10	12 50	46.38	43 10	13	45.92
43 10	13 10	45.39	43 10	13 20	44.89	43 10	13 30	44.37

43 10	13 40	44.02	43 10	13 50	43.87	43 10	14	43.82
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43 10	14 40	44.52	43 10	14 50	44.87	43 10	15	45.25
43	10	49.23	43	10 10	49.32	43	10 20	49.38
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43	12	48.71	43	12 10	48.60	43	12 20	48.30
43	12 30	48.01	43	12 40	47.59	43	12 50	47.32
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43	13 30	44.87	43	13 40	44.30	43	13 50	43.94
43	14	43.85	43	14 10	43.82	43	14 20	44.03
43	14 30	44.31	43	14 40	44.65	43	14 50	45.04
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42 50	12 20	49.02	42 50	12 30	48.73	42 50	12 40	48.19
42 50	12 50	47.85	42 50	13	47.61	42 50	13 10	47.28
42 50	13 20	46.48	42 50	13 30	45.51	42 50	13 40	44.63
42 50	13 50	44.04	42 50	14	43.84	42 50	14 10	43.95
42 50	14 20	44.20	42 50	14 30	44.53	42 50	14 40	44.92
42 50	14 50	45.36	42 50	15	45.82	42 40	11	49.70
42 40	11 10	49.74	42 40	11 20	49.92	42 40	11 30	49.98
42 40	11 40	49.89	42 40	11 50	49.82	42 40	12	49.66
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42 40	13 40	45.48	42 40	13 50	44.71	42 40	14	44.35
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42 40	14 40	45.35	42 40	14 50	45.81	42 40	15	46.30
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42 30	11 30	49.99	42 30	11 40	49.95	42 30	11 50	49.95
42 30	12	49.83	42 30	12 10	49.69	42 30	12 20	49.44
42 30	12 30	49.17	42 30	12 40	48.93	42 30	12 50	48.83
42 30	13	48.74	42 30	13 10	48.46	42 30	13 20	48.13
42 30	13 30	47.38	42 30	13 40	46.68	42 30	13 50	45.94
42 30	14	45.26	42 30	14 10	45.00	42 30	14 20	45.18
42 30	14 30	45.52	42 30	14 40	45.93	42 30	14 50	46.39
42 30	15	46.88	42 20	11	50.06	42 20	11 10	50.07
42 20	11 20	50.06	42 20	11 30	50.02	42 20	11 40	49.98
42 20	11 50	49.96	42 20	12	49.96	42 20	12 10	49.88
42 20	12 20	49.58	42 20	12 30	49.28	42 20	12 40	49.11
42 20	12 50	49.06	42 20	13	48.82	42 20	13 10	48.74
42 20	13 20	48.40	42 20	13 30	48.12	42 20	13 40	47.77
42 20	13 50	47.00	42 20	14	46.17	42 20	14 10	45.91
42 20	14 20	46.01	42 20	14 30	46.26	42 20	14 40	46.62
42 20	14 50	47.05	42 20	15	47.52	42 10	11	50.15
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42 10	11 40	50.06	42 10	11 50	50.01	42 10	12	49.99
42 10	12 10	49.84	42 10	12 20	49.56	42 10	12 30	49.31
42 10	12 40	49.13	42 10	12 50	49.11	42 10	13	49.03
42 10	13 10	49.07	42 10	13 20	48.90	42 10	13 30	48.69
42 10	13 40	48.16	42 10	13 50	47.63	42 10	14	47.29
42 10	14 10	47.08	42 10	14 20	47.03	42 10	14 30	47.14
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42	13	49.13	42	13 10	49.31	42	13 20	49.14
42	13 30	48.97	42	13 40	48.99	42	13 50	48.82

42	14	49.01	42	14 10	48.87	42	14 20	48.55
42	14 30	48.56	42	14 40	48.62	42	14 50	48.75
42	15	48.93	42	15 10	49.35	42	15 20	49.91
42	15 30	50.52	42	15 40	50.95	42	15 50	51.15
42	16	51.21	42	16 10	51.12	42	16 20	50.87
42	16 30	50.46	42	16 40	49.89	42	16 50	49.19
42	17	48.39	41 50	12	50.03	41 50	12 10	49.90
41 50	12 20	49.69	41 50	12 30	49.48	41 50	12 40	49.36
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41 50	14 50	49.38	41 50	15	49.45	41 50	15 10	49.76
41 50	15 20	50.27	41 50	15 30	50.95	41 50	15 40	51.36
41 50	15 50	51.54	41 50	16	51.63	41 50	16 10	51.61
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41 50	16 50	49.84	41 50	17	49.02	41 40	12	50.04
41 40	12 10	49.96	41 40	12 20	49.81	41 40	12 30	49.62
41 40	12 40	49.52	41 40	12 50	49.41	41 40	13	49.32
41 40	13 10	49.22	41 40	13 20	49.18	41 40	13 30	49.12
41 40	13 40	49.17	41 40	13 50	49.43	41 40	14	49.73
41 40	14 10	49.76	41 40	14 20	49.68	41 40	14 30	49.53
41 40	14 40	49.64	41 40	14 50	49.70	41 40	15	49.74
41 40	15 10	49.86	41 40	15 20	50.29	41 40	15 30	50.72
41 40	15 40	51.11	41 40	15 50	51.39	41 40	16	51.59
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41 40	16 40	51.00	41 40	16 50	50.39	41 40	17	49.61
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41 30	9 30	49.30	41 30	9 40	49.33	41 30	9 50	49.32
41 30	10	49.30	41 30	12	49.96	41 30	12 10	49.92
41 30	12 20	49.85	41 30	12 30	49.76	41 30	12 40	49.60
41 30	12 50	49.46	41 30	13	49.39	41 30	13 10	49.33
41 30	13 20	49.27	41 30	13 30	49.21	41 30	13 40	49.22
41 30	13 50	49.28	41 30	14	49.49	41 30	14 10	49.48
41 30	14 20	49.57	41 30	14 30	49.67	41 30	14 40	49.77
41 30	14 50	49.76	41 30	15	49.71	41 30	15 10	49.92
41 30	15 20	50.20	41 30	15 30	50.48	41 30	15 40	50.76
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41 30	16 20	51.34	41 30	16 30	51.17	41 30	16 40	50.85
41 30	16 50	50.36	41 30	17	49.73	41 30	17 10	48.63
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41 30	17 50	45.18	41 30	18	44.30	41 30	18 10	43.50
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41 30	18 50	41.79	41 30	19	41.85	41 20	8	47.84
41 20	8 10	48.14	41 20	8 20	48.39	41 20	8 30	48.62
41 20	8 40	48.83	41 20	8 50	49.02	41 20	9	49.18
41 20	9 10	49.32	41 20	9 20	49.41	41 20	9 30	49.43
41 20	9 40	49.41	41 20	9 50	49.37	41 20	10	49.31
41 20	12	49.79	41 20	12 10	49.81	41 20	12 20	49.81
41 20	12 30	49.78	41 20	12 40	49.71	41 20	12 50	49.61
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41 20	14 30	49.64	41 20	14 40	49.82	41 20	14 50	50.00
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41 20	15 30	50.39	41 20	15 40	50.56	41 20	15 50	50.82
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41 10	8 50	49.29	41 10	9	49.46	41 10	9 10	49.61
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41 10	13 40	49.67	41 10	13 50	49.57	41 10	14	49.60
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40 20	16 30	47.19	40 20	16 40	47.02	40 20	16 50	47.05
40 20	17	47.22	40 20	17 10	47.14	40 20	17 20	46.90
40 20	17 30	46.61	40 20	17 40	46.20	40 20	17 50	45.81
40 20	18	45.32	40 20	18 10	44.72	40 20	18 20	44.03
40 20	18 30	43.26	40 20	18 40	42.46	40 20	18 50	41.74
40 20	19	41.16	40 10	8	48.85	40 10	8 10	49.29
40 10	8 20	49.59	40 10	8 30	49.85	40 10	8 40	50.22
40 10	8 50	50.11	40 10	9	50.31	40 10	9 10	50.72
40 10	9 20	50.75	40 10	9 30	50.56	40 10	9 40	49.93
40 10	9 50	49.35	40 10	10	48.86	40 10	14	49.56
40 10	14 10	50.03	40 10	14 20	50.43	40 10	14 30	50.72
40 10	14 40	50.86	40 10	14 50	50.84	40 10	15	50.71
40 10	15 10	50.65	40 10	15 20	50.72	40 10	15 30	50.17
40 10	15 40	49.99	40 10	15 50	49.68	40 10	16	48.99
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40 10	16 40	45.89	40 10	16 50	46.04	40 10	17	46.15
40 10	17 10	46.10	40 10	17 20	45.86	40 10	17 30	45.55
40 10	17 40	45.23	40 10	17 50	44.97	40 10	18	44.65
40 10	18 10	44.24	40 10	18 20	43.67	40 10	18 30	42.94
40 10	18 40	42.09	40 10	18 50	41.32	40 10	19	40.69
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40	16 50	45.12	40	17	45.02	40	17 10	44.77
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40	18 50	40.56	40	19	39.92	39 50	8	48.62
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39 50	17 30	42.55	39 50	18	42.19	39 50	18 10	42.00
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39 50	18 50	39.45	39 50	19	38.85	39 40	8	48.43
39 40	8 10	48.76	39 40	8 20	48.94	39 40	8 30	48.95
39 40	8 40	48.74	39 40	8 50	48.90	39 40	9	49.27
39 40	9 10	49.70	39 40	9 20	49.83	39 40	9 30	49.59
39 40	9 40	48.90	39 40	9 50	48.46	39 40	10	47.96
39 40	15 30	49.11	39 40	15 40	48.79	39 40	15 50	48.49
39 40	16	48.03	39 40	16 10	46.67	39 40	16 20	45.43
39 40	16 30	44.15	39 40	16 40	43.31	39 40	16 50	42.73
39 40	17	42.29	39 40	17 10	41.84	39 40	17 20	41.36
39 40	17 30	40.89	39 40	18	40.41	39 40	18 10	40.13
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39 40	18 50	38.04	39 40	19	37.52	39 30	8	48.14
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39 30	18 50	36.47	39 30	19	36.05	39 20	8	47.74
39 20	8 10	48.07	39 20	8 20	48.34	39 20	8 30	48.65
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39 20	9 10	48.76	39 20	9 20	49.26	39 20	9 30	48.90
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39 10	16 10	46.70	39 10	16 20	46.38	39 10	16 30	45.84
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39	16 20	45.48	39	16 30	44.50	39	16 40	43.06
39	16 50	41.44	39	17	39.90	39	17 10	38.33
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38 50	8 10	46.23	38 50	8 20	46.46	38 50	8 30	46.70
38 50	8 40	46.94	38 50	8 50	47.13	38 50	9	47.26
38 50	9 10	47.35	38 50	9 20	47.38	38 50	9 30	47.30
38 50	9 40	47.07	38 50	9 50	46.71	38 50	10	46.30
38 50	15 30	45.04	38 50	15 40	44.93	38 50	15 50	44.99
38 50	16	45.08	38 50	16 10	44.82	38 50	16 20	44.09
38 50	16 30	42.94	38 50	16 40	41.45	38 50	16 50	39.89
38 50	17	38.39	38 50	17 10	36.97	38 50	17 20	35.71
38 50	17 30	34.77	38 40	8	45.41	38 40	8 10	45.57
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38 40	8 50	46.42	38 40	9	46.58	38 40	9 10	46.68
38 40	9 20	46.71	38 40	9 30	46.66	38 40	9 40	46.50
38 40	9 50	46.26	38 40	10	45.98	38 40	15 30	44.77
38 40	15 40	44.66	38 40	15 50	44.72	38 40	16	44.93
38 40	16 10	44.44	38 40	16 20	43.35	38 40	16 30	41.86
38 40	16 40	40.03	38 40	16 50	38.34	38 40	17	36.88
38 40	17 10	35.66	38 40	17 20	34.69	38 40	17 30	33.95
38 30	8	44.88	38 30	8 10	45.01	38 30	8 20	45.18
38 30	8 30	45.38	38 30	8 40	45.60	38 30	8 50	45.81
38 30	9	45.99	38 30	9 10	46.11	38 30	9 20	46.18
38 30	9 30	46.17	38 30	9 40	46.08	38 30	9 50	45.94
38 30	10	45.76	38 30	12	46.35	38 30	12 10	46.50
38 30	12 20	46.59	38 30	12 30	46.61	38 30	12 40	46.55
38 30	12 50	46.41	38 30	13	46.20	38 30	13 10	45.91
38 30	13 20	45.59	38 30	13 30	45.26	38 30	13 40	44.98
38 30	13 50	44.81	38 30	14	44.73	38 30	14 10	44.76
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38 30	14 50	45.63	38 30	15	45.83	38 30	15 10	45.96
38 30	15 20	45.97	38 30	15 30	45.02	38 30	15 40	44.76
38 30	15 50	44.45	38 30	16	43.98	38 30	16 10	43.22
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38 30	16 50	37.14	38 30	17	35.77	38 30	17 10	34.74
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38 20	13 40	45.15	38 20	13 50	44.95	38 20	14	44.87
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38 10	13 30	45.54	38 10	13 40	45.24	38 10	13 50	45.09
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38	14 50	46.37	38	15	46.10	38	15 10	45.51
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38	16 20	37.69	38	16 30	36.40	38	16 40	35.36
38	16 50	34.54	38	17	33.94	38	17 10	33.51
38	17 20	33.19	38	17 30	32.91	37 50	12	45.87
37 50	12 10	45.81	37 50	12 20	45.69	37 50	12 30	45.59
37 50	12 40	45.58	37 50	12 50	45.52	37 50	13	45.46
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37 50	13 40	44.60	37 50	13 50	44.43	37 50	14	44.70
37 50	14 10	44.93	37 50	14 20	45.19	37 50	14 30	45.47
37 50	14 40	45.85	37 50	14 50	45.91	37 50	15	45.62
37 50	15 10	44.71	37 50	15 20	43.41	37 50	15 30	42.00
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37 40	15 30	40.96	37 40	15 40	39.73	37 40	15 50	38.57
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37 40	17	33.19	37 40	17 10	33.00	37 40	17 20	32.84
37 40	17 30	32.65	37 30	12	45.18	37 30	12 10	45.02
37 30	12 20	44.79	37 30	12 30	44.54	37 30	12 40	44.27
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37 30	15 50	37.54	37 30	16	36.37	37 30	16 10	35.42
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37 30	16 50	32.99	37 30	17	32.77	37 30	17 10	32.63
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36	40	15		41.95	36	40	15	10	41.01	36	40	15	20	39.68
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