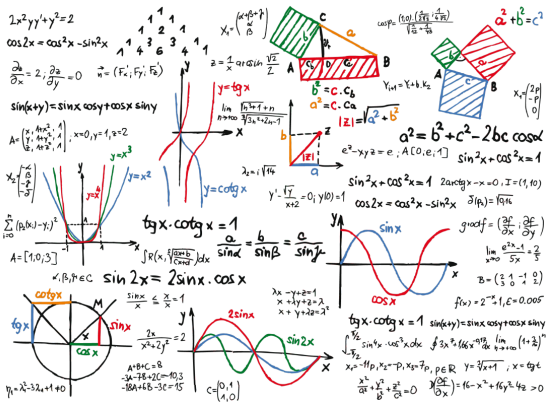

B4- Mathematics

B-MAT-400

208dowels

Quality control, calibration and χ

1.6

Dowels mass-production

Quality control, calibration and χ

binary name:	208dowels
repository name:	208dowels_$ACADEMICYEAR
repository rights:	ramassage-tek
language:	C, C++, perl 5, python 3 (≥ 3.5), ruby 2 (≥ 2.2), php 5.6, bash 4
group size:	1-2
compilation:	via Makefile, including re, clean and fclean rules

- Your repository must contain the totality of your source files, but no useless files (binary, temp files, obj files,...).
- All the bonus files (including a potential specific Makefile) should be in a directory named *bonus*.
- Error messages have to be written on the error output, and the program should then exit with the 84 error code (0 if there is no error).

A power hammer mass produces dowels. Sometimes, some pieces are defective, and the whole process requires quality control: 100 samples of 100 pieces are randomly taken, and defective pieces are numbered. We get what we call an observed serial. Then, a statistical fit is done using the binomial distribution, and validated thanks to the χ^2 test.

This may remind you of something...

Let's note x the number of defective pieces, O_x the size of the observed sample, and T_x the theoretical size.
Moreover, only statistical classes of over 10 elements will be taken into consideration, so that the fit is consistant (which means x values can be joined to obtain sizes bigger than 10); extreme x values will be aggregated first.

Finally, with the number of constraints for the fit being 2, the v parameter of the freedom degrees is equal to the number of classes minus 2.
Your program will take 9 integers as inputs, representing respectively O_0, O_1,...O_{8+}.
It will output :

1. an array showing observed and theoretical sizes for each statistical class (with totals)
2. the chosen probability distribution for the fit,
3. the sum of the square differences,
4. the ν value,
5. the value range in which the probability falls if the fit is valid.

Terminal

```
~/B-MAT-400> ./208dowels -h
USAGE
          ./208dowels O0 O1 O2 O3 O4 O5 O6 O7 O8+

DESCRIPTION
          Oi    size of the observed class
```

Your program output has to be strictly identical to the one below.

Terminal

```
~/B-MAT-400> ./208dowels 6 4 10 18 20 19 11 5 7
   x   |   0-1   |    2    |    3    |    4    |    5    |    6    |    7+   |   total
  Ox   |   10    |    10   |    18   |    20   |    19   |    11   |    12   |   100
  Tx   |   8.0   |   13.8  |   19.2  |   19.9  |   16.3  |   11.1  |   11.7  |   100
distribution:              B(100, 0.041)
sum of the square          2.029
differences:
freedom degrees:           5
fit validity:              80%<P<90%
```

Terminal

```
~/B-MAT-400> ./208dowels 6 4 10 8 20 19 11 5 17
   x   |   0-1   |   2-3   |    4    |    5    |   6-7   |    8+   |   total
  Ox   |   10    |    18   |    20   |    19   |    16   |    17   |   100
  Tx   |   5.2   |   26.7  |   19.1  |   17.7  |   22.2  |   9.0   |   100
distribution:              B(100, 0.046)
sum of the square          16.119
differences:
freedom degrees:           4
fit validity:              P<1%
```

Terminal

```
~/B-MAT-400> ./208dowels 4 5 13 19 20 16 12 7 4
   x   |   0-2   |    3    |    4    |    5    |    6    |    7+   |   total
  Ox   |   22    |    19   |    20   |    16   |    12   |    11   |   100
  Tx   |   23.1  |   19.7  |   19.9  |   16.0  |   10.6  |   10.7  |   100
distribution:              B(100, 0.0401)
sum of the square          0.270
differences:
freedom degrees:           4
fit validity:              P>99%
```

χ^2 distribution table

ν	99%	90%	80%	70%	60%	50%	40%	30%	20%	10%	5%	2%	1%
1	0.00	0.02	0.06	0.15	0.27	0.45	0.71	1.07	1.64	2.71	3.84	5.41	6.63
2	0.02	0.21	0.45	0.71	1.02	1.39	1.83	2.41	3.22	4.61	5.99	7.82	9.21
3	0.11	0.58	1.01	1.42	1.87	2.37	2.95	3.66	4.64	6.25	7.81	9.84	11.35
4	0.30	1.06	1.65	2.19	2.75	3.36	4.04	4.88	5.99	7.78	9.49	11.67	13.28
5	0.55	1.61	2.34	3.00	3.66	4.35	5.13	6.06	7.29	9.24	11.07	13.33	15.01
6	0.70	2.20	3.07	3.83	4.57	5.35	6.21	7.23	8.56	10.64	12.59	15.03	16.81
7	1.24	2.83	3.82	4.67	5.49	6.35	7.28	8.38	9.80	12.02	14.07	16.62	18.48
8	1.65	3.49	4.59	5.53	6.42	7.34	8.35	9.52	11.03	13.36	15.51	18.17	20.09
9	2.09	4.17	5.38	6.39	7.36	8.34	9.41	10.66	12.24	14.68	16.92	19.63	21.67
10	2.56	4.87	6.18	7.27	8.30	9.34	10.47	11.78	13.44	15.99	18.31	21.16	23.21