Probability Analysis for Computer Program

$$ {}_nP_r = \frac{n!}{(n-r)!} \qquad \binom{59}{5} = 600{,}766{,}320 \text{ = Permutations} $$

$$ {}_nC_r = \frac{n!}{(n-r)!r!} \qquad \binom{59}{5} = 5{,}006{,}386 \text{ = Combinations} $$

Because of the magnitute of 59 being applied to n! we get a result of a number that has approximately 81 digits in length.
This exceeds the capability of a 32-bit computer register and therefore a different technique must be used to determine the value.
Example: 59! = 138,683,118,545,690,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000

If we design a technique that can have up to say 126 digits (128 less one for sign and less one for control) we can handle n! values up to a limited value
As the vallue of n-r approaches the this same magnitute we have the same condition that will apply also.
Actual analysis shows us that when we get a value of 13 or higher, we must use another technique, as 13! exceeds 32-bit limit.

There is a possibility that we can breakdown the two formulas to allow us to used the 32-bit computer registers without using a alternate technique.
Example:

$$ nPr = (59)P(5) = \frac{(59)!}{(59-5)!} = \frac{59 * 58 * 57 * 56 * 55 * \cancel{54!}}{\cancel{54!}} = \frac{59 * 58 * 57 * 56 * 55}{1} = \frac{600{,}766{,}320}{1} = 600{,}766{,}320 $$

This brealdown allows us to use standard registers at this level of inputed parameters.
Now we need to test the Combinations function in a similar manner
Example:

$$ nCr = (59)C(5) = \frac{(59)!}{(59-5)!5!} = \frac{59 * 58 * 57 * 56 * 55 * \cancel{54!}}{\cancel{54!} * 5 * 4 * 3 * 2 * 1} = \frac{59 * 58 * 57 * 56 * 55}{5 * 4 * 3 * 2 * 1} = \frac{600{,}766{,}320}{120} = 5{,}006{,}386 $$

This brealdown allows us to use standard registers at this level of inputed parameters.
Our breakdown technique works great for both Functions, now lets test the technique for maximum capacity
We only have to test the numerator with the top five numbers multiplied together so as no to exceed 4 gig (32 bit limit)

Factorials	
1	1
2	2
3	6
4	24
5	120
6	720
7	5,040
8	40,320
9	362,880
10	3,628,800
11	39,916,800
12	479,001,600
13	6,227,020,800

Register Basis Fail points

59	600,766,320	Ok
60	655,381,440	Ok
61	713,897,640	Ok
62	776,520,240	Ok
63	843,461,640	Ok
64	914,941,440	Ok
65	991,186,560	Ok
66	1,072,431,360	Ok
67	1,158,917,760	Ok
68	1,250,895,360	Ok
69	1,348,621,560	Ok
70	1,452,361,680	Ok
71	1,562,389,080	Ok
72	1,678,985,280	Ok
73	1,802,440,080	Ok
74	1,933,051,680	Ok
75	2,071,126,800	Ok
76	2,216,980,800	Ok
77	2,370,937,800	Ok
78	2,533,330,800	Ok
79	2,704,501,800	Ok
80	2,884,801,920	Ok
81	3,074,591,520	Ok
82	3,274,240,320	Ok
83	3,484,127,520	Ok
84	3,704,641,920	Ok
85	3,936,182,040	Ok
86	4,179,156,240	Ok
87	4,433,982,840	Bad
88	4,701,090,240	Bad

Breakdown steps for Permatation

1 Numerator
- a Use the formula [n * (n-1) * (n-2) * (n-3) * (n-4)]
- b The result of 1a is our answer for the numerator

2 Denominator
- a Default to 1

3 Perform division
4 Provide answer

Breakdown steps for Combination

1 Numerator
- a Use the formula [n * (n-1) * (n-2) * (n-3) * (n-4)]
- b The result of 1a is our answer for the numerator

2 Denominator
- a Eliminate the n-r portion entrirely
- b Compute factorial r!

Note we are limited to values between 1 and 12 here

3 Perform division
4 Provide answer

Rules (using registers only)

Max value for n is = 86

Max value for r
Permations = 5
Combinations = 12

Create table for rules for all values of n and r for both functions