Joint Arrays All Combinations and by Random Subset

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Given Several Arrays, General all Possible Combinations

There are several parameters, might want to simulate at all possible combinations. In the example below, there are four parameters, generate a table with all possible combinations of the four parameters.

```
%% A. Quadc linh refh and refsd parameter grids
[it_p1, it_p2, it_p3] = deal(4, 3, 3);
ar_p1 = linspace(-0.09, -0.02, it_p1);
ar p2 = linspace( 0.020, 0.100, it p2);
ar_p3 = linspace(-0.100, -0.020, it_p3);
ar_p4 = [0.05];
%% B. Mesh Parameters together
% ndgrid mesh together
[mn_p1, ~] = ndgrid(ar_p1, ar_p2, ar_p3, ar_p4);
% combine
[ar_p1_idx, ar_p2_idx, ar_p3_idx, ar_p4_idx] = ind2sub(size(mn_p1), find(mn_p1));
% Index and values
ar_p1_flat = ar_p1(ar_p1_idx)';
ar p2 flat = ar p2(ar p2 idx)';
ar_p3_flat = ar_p3(ar_p3_idx)';
ar_p4_flat = ar_p4(ar_p4_idx)';
mt_paramsmesh_long = [ar_p1_idx(:), ar_p1_flat(:), ...
    ar_p2_idx(:), ar_p2_flat(:), ...
    ar_p3_idx(:), ar_p3_flat(:), ...
    ar_p4_idx(:), ar_p4_flat(:)];
% Sort by a and z
mt_paramsmesh_long = sortrows(mt_paramsmesh_long, [1,3, 5]);
% C. Create Table
tb paramsmesh long = array2table(mt paramsmesh long);
cl col names a = {'quadc idx', 'quadc val', ...
    'linh_idx', 'linh_val', ...
    'refh_idx', 'rehfh_val', ...
'refsd_idx', 'rehfsd_val'};
tb_paramsmesh_long.Properties.VariableNames = cl_col_names_a;
% D. Display Table
disp(tb paramsmesh long);
```

quadc_idx	quadc_val	linh_idx	linh_val	refh_idx	rehfh_val	refsd_idx	rehfsd_val
							
1	-0.09	1	0.02	1	-0.1	1	0.05
1	-0.09	1	0.02	2	-0.06	1	0.05
1	-0.09	1	0.02	3	-0.02	1	0.05
1	-0.09	2	0.06	1	-0.1	1	0.05
1	-0.09	2	0.06	2	-0.06	1	0.05
1	-0.09	2	0.06	3	-0.02	1	0.05
1	-0.09	3	0.1	1	-0.1	1	0.05
1	-0.09	3	0.1	2	-0.06	1	0.05
1	-0.09	3	0.1	3	-0.02	1	0.05

2	-0.066667	1	0.02	1	-0.1	1	0.05
2	-0.066667	1	0.02	2	-0.06	1	0.05
2	-0.066667	1	0.02	3	-0.02	1	0.05
2	-0.066667	2	0.06	1	-0.1	1	0.05
2	-0.066667	2	0.06	2	-0.06	1	0.05
2	-0.066667	2	0.06	3	-0.02	1	0.05
2	-0.066667	3	0.1	1	-0.1	1	0.05
2	-0.066667	3	0.1	2	-0.06	1	0.05
2	-0.066667	3	0.1	3	-0.02	1	0.05
3	-0.043333	1	0.02	1	-0.1	1	0.05
3	-0.043333	1	0.02	2	-0.06	1	0.05
3	-0.043333	1	0.02	3	-0.02	1	0.05
3	-0.043333	2	0.06	1	-0.1	1	0.05
3	-0.043333	2	0.06	2	-0.06	1	0.05
3	-0.043333	2	0.06	3	-0.02	1	0.05
3	-0.043333	3	0.1	1	-0.1	1	0.05
3	-0.043333	3	0.1	2	-0.06	1	0.05
3	-0.043333	3	0.1	3	-0.02	1	0.05
4	-0.02	1	0.02	1	-0.1	1	0.05
4	-0.02	1	0.02	2	-0.06	1	0.05
4	-0.02	1	0.02	3	-0.02	1	0.05
4	-0.02	2	0.06	1	-0.1	1	0.05
4	-0.02	2	0.06	2	-0.06	1	0.05
4	-0.02	2	0.06	3	-0.02	1	0.05
4	-0.02	3	0.1	1	-0.1	1	0.05
4	-0.02	3	0.1	2	-0.06	1	0.05
4	-0.02	3	0.1	3	-0.02	1	0.05

Matlab Draw Random with and without Replacement

```
%Generate a matrix named foo, with limited numbers
rng(1234);
foo = unique((round((randn(5,1)+1)*100)));
disp(foo);
```

```
% draw 10 random samples without replacement
index = randsample(1:length(foo), 4);
bar_rand_noreplace = foo(index,:);

% draw 1000 random samples with replacement
index = randsample(1:length(foo), 4, true);
bar_rand_replace = foo(index,:);

% Display
disp(table(bar_rand_noreplace, bar_rand_replace));
```

bar_rand_noreplace	bar_rand_replace		
5	78		
78	154		
154	219		
232	219		

Matrix Meshgrid to Loop Permutated Vectors

Meshgrid to generate all permutations of arrays.

```
k = linspace(1,10,10);
kp = linspace(1,10,10);
z = linspace(0,1,10);
[kM kpM zM] = meshgrid(k,kp,z);
kMVec = kM(:);
kMpVec = kpM(:);
zMVec = zM(:);
outputVec = zeros(size(zMVec));
for a=1:length(zMVec)
     outputVec(a) = kMVec(a)+kMpVec(a);
end
outputTens = reshape(outputVec,size(kM));
disp(outputTens);
(:,:,1) =
    2
        3
             4
                   5
                            7
                                 8
                                      9
                                           10
                       6
                                                11
        4
             5
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    3
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    4
        5
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                       10 11
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                       11 12
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                       13 14
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                                                18
   10
             12 13
                      14 15 16
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                                                19
        11
             13 14 15 16 17
                                           19
(:,:,2) =
                            5.1111
                                    6.1111
                                            7.1111
                                                    8.1111
                                                           9.1111 10.1111
   2.1111
           3.1111
                   4.1111
                                                                             11.1111
                                                   9.1111 10.1111 11.1111 12.1111
                 5.1111
                                   7.1111
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                                          9.1111 10.1111 11.1111 12.1111 13.1111
                                   8.1111
   4.1111
           5.1111
                   6.1111
                 7.1111
                                   9.1111 10.1111 11.1111 12.1111 13.1111
   5.1111
           6.1111
                           8.1111
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                                   10.1111 11.1111
                                                    12.1111
   6.1111
           7.1111
                   8.1111
                           9.1111
                                                            13.1111
                                                                     14.1111
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                           10.1111 11.1111 12.1111 13.1111
           8.1111
                   9.1111
                                                                             16.1111
   7.1111
                                                            14.1111
                                                                    15.1111
   8.1111
          9.1111 10.1111 11.1111 12.1111 13.1111 14.1111 15.1111
                                                                    16.1111
                                                                             17.1111
   9.1111 10.1111 11.1111 12.1111 13.1111 14.1111 15.1111 16.1111 17.1111
                                                                             18.1111
  10.1111 \quad 11.1111 \quad 12.1111 \quad 13.1111 \quad 14.1111 \quad 15.1111 \quad 16.1111 \quad 17.1111 \quad 18.1111 \quad 19.1111
  11.1111 12.1111 13.1111 14.1111 15.1111 16.1111 17.1111 18.1111 19.1111
                                                                             20.1111
(:,:,3) =
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   2.2222
           3.2222
                   4.2222
                            5.2222
                                    6.2222
                                            7.2222
                                                    8.2222
                                                                     10.2222
                                                                             11.2222
   3.2222
           4.2222 5.2222
                            6.2222 7.2222
                                            8.2222 9.2222 10.2222 11.2222
                                                                             12.2222
   4.2222
         5.222 6.222 7.222 8.222 9.222 10.222 11.222 12.222
                                                                            13.2222
         6.222 7.222 8.222 9.222 10.222 11.222 12.222 13.222
   5.2222
                                                                            14.2222
   6.222 7.222 8.222 9.222 10.222 11.222 12.222 13.222 14.222 15.222
   7.2222
         8.2222
                 9.2222 10.2222 11.2222 12.2222 13.2222 14.2222 15.2222 16.2222
          9.2222 10.2222 11.2222 12.2222 13.2222 14.2222 15.2222 16.2222 17.2222
   8.2222
   9.2222 10.2222 11.2222
                          12.2222 13.2222 14.2222 15.2222 16.2222 17.2222
                                                                             18.2222
          11.2222 12.2222 13.2222 14.2222 15.2222 16.2222 17.2222 18.2222 19.2222
  10.2222
```

11.2222	12.2222	13.2222	14.2222	15.2222	16.2222	17.2222	18.2222	19.2222	20.2222
(:,:,4) =									
2.3333 3.3333	3.3333 4.3333	4.3333 5.3333	5.3333 6.3333	6.3333 7.3333	7.3333 8.3333	8.3333 9.3333	9.3333 10.3333	10.3333 11.3333	11.3333 12.3333
4.3333	5.3333	6.3333	7.3333	8.3333	9.3333	10.3333	11.3333	12.3333	13.3333
5.3333	6.3333	7.3333	8.3333	9.3333	10.3333	11.3333	12.3333	13.3333	14.3333
6.3333	7.3333	8.3333	9.3333	10.3333	11.3333	12.3333	13.3333	14.3333	15.3333
7.3333	8.3333	9.3333	10.3333	11.3333	12.3333	13.3333	14.3333	15.3333	16.3333
8.3333	9.3333	10.3333	11.3333	12.3333	13.3333	14.3333	15.3333	16.3333	17.3333
9.3333	10.3333	11.3333	12.3333	13.3333	14.3333	15.3333	16.3333	17.3333	18.3333
10.3333	11.3333	12.3333	13.3333	14.3333	15.3333	16.3333	17.3333	18.3333	19.3333
11.3333	12.3333	13.3333	14.3333	15.3333	16.3333	17.3333	18.3333	19.3333	20.3333
(:,:,5) =									
2.4444	3.4444	4.4444	5.4444	6.4444	7.4444	8.4444	9.4444	10.4444	11.4444
3.4444	4.4444	5.4444	6.4444	7.4444	8.4444	9.4444	10.4444	11.4444	12.4444
4.4444	5.4444	6.4444	7.4444	8.4444	9.4444	10.4444	11.4444	12.4444	13.4444
5.4444	6.4444	7.4444	8.4444	9.4444	10.4444	11.4444	12.4444	13.4444	14.4444
6.4444	7.4444	8.4444	9.4444	10.4444	11.4444	12.4444	13.4444	14.4444	15.4444
7.4444 8.4444	8.4444 9.4444	9.4444	10.4444	11.4444	12.4444	13.4444 14.4444	14.4444	15.4444 16.4444	16.4444 17.4444
8.4444 9.4444	10.4444	10.4444 11.4444	11.4444 12.4444	12.4444 13.4444	13.4444 14.4444	15.4444	15.4444 16.4444	17.4444	18.4444
10.4444	11.4444	12.4444	13.4444	14.4444	15.4444	16.4444	17.4444	18.4444	19.4444
11.4444	12.4444	13.4444	14.4444	15.4444	16.4444	17.4444	18.4444	19.4444	20.4444
	,		,,		20,	_,,,,,,,,	20,		
(:,:,6) =									
2.5556	3.5556	4.5556	5.5556	6.5556	7.5556	8.5556	9.5556	10.5556	11.5556
3.5556	4.5556	5.5556	6.5556	7.5556	8.5556	9.5556	10.5556	11.5556	12.5556
4.5556	5.5556	6.5556	7.5556	8.5556	9.5556	10.5556	11.5556	12.5556	13.5556
5.5556	6.5556	7.5556	8.5556	9.5556	10.5556	11.5556	12.5556	13.5556	14.5556
6.5556 7.5556	7.5556	8.5556 9.5556	9.5556	10.5556 11.5556	11.5556	12.5556 13.5556	13.5556 14.5556	14.5556	15.5556 16.5556
8.5556	8.5556 9.5556	10.5556	10.5556 11.5556	12.5556	12.5556 13.5556	14.5556	15.5556	15.5556 16.5556	17.5556
9.5556	10.5556	11.5556	12.5556	13.5556	14.5556	15.5556	16.5556	17.5556	18.5556
10.5556	11.5556	12.5556	13.5556	14.5556	15.5556	16.5556	17.5556	18.5556	19.5556
11.5556	12.5556	13.5556	14.5556	15.5556	16.5556	17.5556	18.5556	19.5556	20.5556
(:,:,7) =									
2 6667	2 6667	4 6667	F 6667	C CCC-	7 6667	0 6667	0.6667	10 6667	11 6667
2.6667	3.6667	4.6667	5.6667	6.6667	7.6667	8.6667	9.6667	10.6667	11.6667
3.6667 4.6667	4.6667 5.6667	5.6667 6.6667	6.6667 7.6667	7.6667 8.6667	8.6667 9.6667	9.6667 10.6667	10.6667 11.6667	11.6667 12.6667	12.6667 13.6667
5.6667	6.6667	7.6667	8.6667	9.6667	10.6667	11.6667	12.6667	13.6667	14.6667
6.6667	7.6667	8.6667	9.6667	10.6667	11.6667	12.6667	13.6667	14.6667	15.6667
7.6667	8.6667	9.6667	10.6667	11.6667	12.6667	13.6667	14.6667	15.6667	16.6667
8.6667	9.6667	10.6667	11.6667	12.6667	13.6667	14.6667	15.6667	16.6667	17.6667
9.6667	10.6667	11.6667	12.6667	13.6667	14.6667	15.6667	16.6667	17.6667	18.6667
10.6667	11.6667	12.6667	13.6667	14.6667	15.6667	16.6667	17.6667	18.6667	19.6667
11.6667	12.6667	13.6667	14.6667	15.6667	16.6667	17.6667	18.6667	19.6667	20.6667
(:,:,8) =									
2 7770	3.7778	A 7770	5 7770	6 7770	7.7778	Q 7770	9.7778	10 7770	11.7778
2.7778 3.7778	3.7778 4.7778	4.7778 5.7778	5.7778 6.7778	6.7778 7.7778	7.7778 8.7778	8.7778 9.7778	9.7778	10.7778 11.7778	12.7778
4.7778	5.7778	6.7778	7.7778	8.7778	9.7778	10.7778	11.7778	12.7778	13.7778
5.7778	6.7778	7.7778	8.7778	9.7778	10.7778	11.7778	12.7778	13.7778	14.7778

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(:,:,9) =
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(:,:,10) =
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```

Given Integer Arrays, All Possible Combinations

given any sizes arrays, N of them, create all possible combinations

```
ar_it_a = 1:3;
ar_it_b = 1:2;
ar_it_c = 2:4;
ar_it_d = -1:-1:-2;
ar_it_e = 0.1;
cl_ar_all = {ar_it_a, ar_it_b, ar_it_c, ar_it_d, ar_it_e};
cl_mt_all = cl_ar_all;
[cl_mt_all{:}] = ndgrid(cl_ar_all{:});
mt_it_allcombo = cell2mat(cellfun(@(m) m(:), cl_mt_all, 'uni', 0));
disp(mt_it_allcombo)
```

```
1.0000
           1.0000
                     2.0000
                                -1.0000
                                            0.1000
2.0000
           1.0000
                     2.0000
                                -1.0000
                                            0.1000
3.0000
           1.0000
                     2.0000
                                -1.0000
                                            0.1000
1.0000
           2.0000
                     2.0000
                                -1.0000
                                            0.1000
2.0000
           2.0000
                     2.0000
                                -1.0000
                                            0.1000
3.0000
           2.0000
                     2.0000
                                -1.0000
                                            0.1000
1.0000
          1.0000
                     3.0000
                                -1.0000
                                            0.1000
2.0000
          1.0000
                     3.0000
                                -1.0000
                                            0.1000
3.0000
          1.0000
                     3.0000
                                -1.0000
                                            0.1000
```

1.0000	2.0000	3.0000	-1.0000	0.1000
2.0000	2.0000	3.0000	-1.0000	0.1000
3.0000	2.0000	3.0000	-1.0000	0.1000
1.0000	1.0000	4.0000	-1.0000	0.1000
2.0000	1.0000	4.0000	-1.0000	0.1000
3.0000	1.0000	4.0000	-1.0000	0.1000
1.0000	2.0000	4.0000	-1.0000	0.1000
2.0000	2.0000	4.0000	-1.0000	0.1000
3.0000	2.0000	4.0000	-1.0000	0.1000
1.0000	1.0000	2.0000	-2.0000	0.1000
2.0000	1.0000	2.0000	-2.0000	0.1000
3.0000	1.0000	2.0000	-2.0000	0.1000
1.0000	2.0000	2.0000	-2.0000	0.1000
2.0000	2.0000	2.0000	-2.0000	0.1000
3.0000	2.0000	2.0000	-2.0000	0.1000
1.0000	1.0000	3.0000	-2.0000	0.1000
2.0000	1.0000	3.0000	-2.0000	0.1000
3.0000	1.0000	3.0000	-2.0000	0.1000
1.0000	2.0000	3.0000	-2.0000	0.1000
2.0000	2.0000	3.0000	-2.0000	0.1000
3.0000	2.0000	3.0000	-2.0000	0.1000
1.0000	1.0000	4.0000	-2.0000	0.1000
2.0000	1.0000	4.0000	-2.0000	0.1000
3.0000	1.0000	4.0000	-2.0000	0.1000
1.0000	2.0000	4.0000	-2.0000	0.1000
2.0000	2.0000	4.0000	-2.0000	0.1000
3.0000	2.0000	4.0000	-2.0000	0.1000