

Stochastic Programming Workbook

1- Bin Method

SPW1

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Tutorial

SPW1.xls Workbook Tool Overview

CP mean & standard deviation for each ingredient

Ingredients Composition Matrix

The minimum specifications & and the maximum levels of nutrients

The supplied amount of each nutrient in the final formula P=0.5

The average nutrient content at the specified probability level

	A	E	C	F	G	H	I	J	K	L	M	N	O	P	Q
		Corn	SDM	Poultry fat	Limestone	DCP	Vitamin premix	Mineral premix	salt	DL-Met	MIN (Nutrient)	MAX (Nutrient)	Supplied	Average content	
2	Cost (\$)	16.00	28.00	34.00	3.00	20.00	370.00	57.00	2.78	220.00					
3	Weight	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
4	CP	6.90	47.51	0.00	0.00	0.00	0.00	0.00	0.00	57.52	23.00	100	23.00	23.00	
5	CP SD	0.59	1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.87	0.87	
6	ME	3.35	2.44	8.20	0.00	0.00	0.00	0.00	0.00	3.51	3.20	100	3.20	3.20	
7	Ca	0.02	0.27	0.00	38.00	21.30	0.00	0.00	0.30	0.00	1.00	100	1.00	1.00	
8	NPP	0.13	0.40	0.00	0.00	18.70	0.00	0.00	0.00	0.00	0.45	100	0.45	0.45	
9	ISAA	0.29	1.28	0.00	0.00	0.00	0.00	0.00	0.00	98.00	0.90	100	0.90	0.90	
10	Met	0.14	0.62	0.00	0.00	0.00	0.00	0.00	0.00	98.00	0.50	100	0.50	0.50	
11	Cysteine	0.15	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100	0.34	0.34	
12	Lysine	0.20	2.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	100	1.28	1.28	
13	Arginine	0.32	3.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.25	100	1.55	1.55	
14	Valine	0.32	2.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	100	1.08	1.08	
15	Tryptophan	0.06	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	100	0.29	0.29	
16	phenylalanine	0.33	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	100	1.15	1.15	
17	Threonine	0.21	1.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	100	0.87	0.87	
18	Isoleucine	0.23	2.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	100	0.99	0.99	
19	Histidine	0.19	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	100	0.58	0.58	
20	sigma^2*Xj^2	0.08	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
21	Quantities	0.48	0.41	0.07	0.02	0.01	0.00	0.00	0.00	0.00					
22	MIN (Ingredient)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
23	MAX (Ingredient)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00					
24	Cost/Ingredient	7.63	11.53	2.44	0.05	0.24	0.93	0.00	0.01	0.53					
25	Formula cost \$	23.45													
26	Z value	0.00													
27	Probability	0.50													

The minimum & maximum levels for each ingredient in the final formula

The desired probability of success to meet the specified protein level in feed

SPW1.xls Workbook Tool Overview

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1								Formula Cost =	\$23.45								
2																	
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Ingredient	Cost \$/cwt	Min. %	Amount %	Max. %
Corn	16.00	0.00	47.72	100.00
SBM	28.00	0.00	41.19	100.00
Poultry fat	34.00	0.00	7.17	100.00
Limestone	3.00	0.00	1.64	100.00
DCP	20.00	0.00	1.19	100.00
Vitamin premix	370.00	0.25	0.25	100.00
Mineral premix	57.00	0.15	0.15	100.00
salt	2.73	0.45	0.45	100.00
DL-Met	220.00	0.00	0.24	100.00
TOTAL			100.00	

Nutrient	Required	Supplied	Max.	Units
ME	3.20	3.20	100.00	Mcal
CP	23.00	23.00	100.00	%
Ca	1.00	1.00	100.00	%
NPP	0.45	0.45	100.00	%
TSAA	0.90	0.90	100.00	%
Lysine	1.10	1.28	100.00	%
Threonine	0.80	0.87	100.00	%
Met	0.50	0.56	100.00	%
Cysteine	0.00	0.34	100.00	%
Arginine	1.25	1.55	100.00	%
Valine	0.90	1.08	100.00	%
phenylalanine	0.72	1.15	100.00	%
Tryptophan	0.20	0.29	100.00	%
isoleucine	0.80	0.99	100.00	%
Histidine	0.35	0.58	100.00	%

Stochastic Outputs

	A	B	C	F	G	H	I	J	K	L	M	N	O	P
		Com	SDM	Poultry fat	Limestone	DCP	Vitamin premix	Mineral premix	salt	DL-Met	MIN (Nutrient)	MAX (Nutrient)	Supplied	Average content
2	Cost (\$)	15.00	28.00	34.00	3.00	20.00	370.00	57.00	2.78	220.00			1.00	1.00
3	weight	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	CP	6.90	47.51	0.00	0.00	0.00	0.00	0.00	0.00	57.52	23.00	100	23.00	23.17
5	CP SD	0.59	1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.87	0.87
6	ME	3.35	2.44	8.20	0.00	0.00	0.00	0.00	0.00	3.81	3.20	100	3.20	3.20
7	Ca	0.02	0.27										1.00	1.00
8	NPP	0.13	0.40										0.45	0.45
9	TSAA	0.29	1.28										0.90	0.90
10	Met	0.14	0.62										0.56	0.56
11	Cysteine	0.15	0.65										0.34	0.34
12	Lysine	0.20	2.88										1.29	1.29
13	Arginine	0.02	3.40										1.57	1.57
14	Valine	0.32	2.25										1.09	1.09
15	Tryptophan	0.05	0.61										0.29	0.29
16	phenylalanine	0.33	2.40										1.15	1.15
17	Threonine	0.24	1.83										0.88	0.88
18	Isoleucine	0.23	2.14										1.00	1.00
19	Histidine	0.15	1.19										0.59	0.59
20	$\sigma^2 \sum x_j^2$	0.05	0.35											
21	Quantities	0.47	0.42	0.07	0.02	0.01	0.00	0.00	0.00	0.00				
22	MIN (Ingredient)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
23	MAX (Ingredient)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
24	Cost/Ingredient	7.58	11.65	2.48	0.05	0.24	0.93	0.09	0.01	0.52				
25	Formula cost \$	25.50												
26	Z value	-0.25												
27	Probability	0.50												

Using the current settings (ingredients composition matrix, minimum specifications, CP statistics... etc.) the workbook can be used as following:

Optimizing the Stochastic Feed Formulation Problem

(1) Select the desired probability of success (between 0 & 1)

(2) Select the solver option

(3) Click solve

	Corn	SUM	Poultry fat	Limestone
1				
2 Cost (\$)	16.00	28.00	34.00	3.00
3 weight	1.00	1.00	1.00	1.00
4 CP	0.90	47.51	0.00	0.00
5 CP:SD	0.59	1.42	0.00	0.00
6 MI	0.08	2.44	0.20	0.00
7 Ca	0.27	0.27	0.00	38.00
8 NDF	0.13	0.40	0.00	0.00
9 TSAA				
10 Met				
11 Cysto				
12 Lysin				
13 Argin				
14 Valin				
15 Trypt				
16 phen				
17 Threo				
18 Isolev				
19 Histidine	0.15	1.19	0.00	0.00
20 sigma ² Xj ²	0.00	0.36	0.00	0.00
21 Quantities	0.47	0.42	0.07	0.07
22 MIN (Ingredient)	0.00	0.00	0.00	0.00
23 MAX (Ingredient)	1.00	1.00	1.00	1.00
24 Cost/Ingredient	7.56	11.65	2.46	0.05
25 Formula cost \$	28.50			
26 Z-value	-6.35			
27 Probability	0.50			

Optimizing the Stochastic Feed Formulation Problem

	A	B	C	F	G	H	I	J	K	L	M	N	O	P
1		Corn	SBM	Poultry fat	Limestone	DCP	Vitamin premix	Mineral premix	salt	DL-Met	MIN (Nutrient)	MAX (Nutrient)	Supplied	Average content
2	Cost (\$)	16.00	28.00	34.00	3.00	20.00	370.00	57.00	2.78	220.00				
3	weight	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	CP	6.90	47.51	0.00	0.00	0.00	0.00	0.00	0.00	57.52	23.00	100	23.00	23.17
5	CP SD	0.59	1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.87	0.87
6	ME	3.35	2.44	8.20	0.00	0.00	0.00	0.00	0.00	3.61	3.20	100	3.20	3.20
7	Ca	0.02	0.27	0.00	38.00	21.30	0.00	0.00	0.30	0.00	1.00	100	1.00	1.00
8	NPP	0.13	0.40	0.00	0.00	18.70	0.00	0.00	0.00	0.00	0.45	100	0.45	0.45
9	TSAA	0.29	1.28	0.00	0.00	0.00	0.00	0.00	0.00					
10	Met	0.14	0.62	0.00	0.00	0.00	0.00	0.00	0.00					
11	Cysteine	0.15	0.60	0.00	0.00	0.00	0.00	0.00	0.00					
12	Lysine	0.20	2.88	0.00	0.00	0.00	0.00	0.00	0.00					
13	Arginine	0.32	3.40	0.00	0.00	0.00	0.00	0.00	0.00					
14	Valine	0.32	2.25	0.00	0.00	0.00	0.00	0.00	0.00					
15	Tryptophan	0.06	0.64	0.00	0.00	0.00	0.00	0.00	0.00					
16	phenylalanine	0.30	2.40	0.00	0.00	0.00	0.00	0.00	0.00					
17	Threonine	0.24	1.83	0.00	0.00	0.00	0.00	0.00	0.00					
18	Isoleucine	0.23	2.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	100	1.00	1.00
19	Histidine	0.19	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	100	0.59	0.59
20	$\sigma^2 \sum X_i^2$	0.08	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
21	Quantities	0.47	0.42	0.07	0.02	0.01	0.00	0.00	0.00	0.00				
22	MIN (Ingredient)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
23	MAX (Ingredient)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
24	Cost/Ingredient	7.56	11.65	2.46	0.05	0.24	0.93	0.09	0.01	0.52				
25	Formula cost \$	23.50												
26	z-value	-0.25												
27	Probability	0.60												

To be 60% sure that the feed contains at least 23% the average content has to be increased to 23.17%

Optimizing the Stochastic Feed Formulation Problem

Ingredient	Cost \$/cwt	Min. %	Amount %	Max. %
Corn	16.00	0.00	47.23	100.00
SRM	28.00	0.00	41.61	100.00
Poultry fat	34.00	0.00	7.24	100.00
Limestone	3.00	0.00	1.64	100.00
DCP	20.00	0.00	1.19	100.00
Vitamin premix	370.00	0.25	0.25	100.00
Mineral premix	57.00	0.15	0.15	100.00
salt	2.78	0.45	0.45	100.00
DI-Mer	220.00	0.00	0.74	100.00
TOTAL			100.00	

Nutrient	Required	Supplied	Max.	Units
ME	3.20	3.20	100.00	Mcal
CP	23.00	23.00	100.00	%
Ca	1.00	1.00	100.00	%
NPP	0.45	0.45	100.00	%
phenylalanine	0.72	1.15	100.00	%
Tryptophan	0.20	0.29	100.00	%
isoleucine	0.00	1.00	100.00	%
Histidine	0.35	0.59	100.00	%

Formula Cost = \$23.50

Ingredient usage and formula cost have changed as the probability of success changed

Worksheet: Stochastic Outputs