

Application of Programmable Calculators to Mastitis Control Programs

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ABSTRACT

Three programs pertaining to sub-clinical mastitis losses and control are described for use in handheld programmable calculators. Subclinical mastitis losses are calculated on the basis of lost milk estimates from California Mastitis Test evaluations. A cost profile for control programs using costs of single use towels, teat dips, and dry cow treatment is described. The cost-benefit value of a mass lactating cow antibiotic treatment regimen is presented. The programs quickly calculate the magnitude of the present subclinical mastitis loss, estimate the cost of control programs, and present information to aid in deciding whether to treat all the infected cows during lactation in an effort to reduce herd infection. User instructions and program listings are included.

INTRODUCTION

Reduced milk production from dairy cows with subclinical mastitis has been responsible for the largest portion of the loss from mastitis. This loss has been estimated to be 386 kg per cow per year in lost production with another 62 kg per cow per year lost in discarded milk (1). Dairywomen are often unaware of the lost production from subclinical mastitis. When dairywomen are shown the extent of this loss in their herds, they usually are more willing to begin programs to control mastitis losses. This article presents several programs for handheld programmable calculators to illustrate mastitis losses from California Mastitis Test (CMT) results, to present cost analysis for towel, dips, and dry cow programs, and to project cost of blitz treatments.

Mastitis Losses

Production losses have been estimated from CMT scores on quarter, cow, and bulk tank samples. Foster found that on quarter samples CMT scores of 1, 2, and 3 were associated with losses of production of 19.5%, 31.8%, and 43.4% per quarter per day (2). Natzke (2) found similar losses of 19%, 29%, and 67% for CMT 1, 2, and 3 scores (4). Philpot found losses for the same scores of 11.4%, 25.6%, and 45.5% (5). The calculator uses a combination from these references for CMT reaction and estimates loss of 15% for CMT 1, 28% for CMT 2, and 44% for CMT 3. The program assumes that total possible production (X) is the sum of the actual daily production and lost production from subclinical mastitis. Therefore,

$$X = \text{lb production} + \% \text{ loss } (X)$$

When the equation is solved for X after substituting one of the CMT loss estimates, the loss factors for the program become .85, .72, and .56. Other factors can be used by other program users if these seem more reasonable.

As an example, for a milking herd of 120 cows producing 45 lb per cow per day, the CMT 1, 2, and 3 readings were 12, 18, and 25 quarters from 50 CMT evaluated cows. The price of milk was \$12.50/cwt. Losses were: 776.02 lb/day; \$97.99/day; \$2,910.08/mo; \$24.25/cow/mo. The program also calculates savings of a mastitis control program with a target goal of CMT scores as 10% CMT1, 3% CMT 2, and 2% CMT 3. The savings estimate would be: 539 lb/day; \$67.39/day; \$2,021.65/mo; \$16.85/cow/mo.

Dairy Herd Improvement Association (DHIA) CMT record information can be used in another program to calculate mastitis losses. Likewise, the Wisconsin Mastitis Test (WMT) scores also could be used to estimate losses on bulk tank score.

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Control Program Cost

Once the dairymen has been appraised of the approximate mastitis loss in his herd from subclinical mastitis, the time is right to analyze the cost of a control program. Under most circumstances, this means using individual towels for drying udders, teat dipping after each milking, and dry treating each quarter at the end of each lactation. The variables for this program include the cost of towels, dip, and dry cow antibiotic treatment.

For the same 120-cow herd with 85% of the cows in milk, twice per day milking, and a 13-mo calving interval, the following results can be developed: \$372.30 cost of towels; \$443.08 cost of teat dip; \$1,028.16 cost of dry cow drugs; \$1,843.54 total cost; \$153.63 cost per mo.

Based on several large research projects, this type of program along with good milking technique and routine milking machine function tests would be expected to reduce greatly mastitis loss in 6 mo to a year after a program is begun. The total monthly cost for the program of \$153.63 would be more than offset by the predicted \$2,021.65 savings when the target goal of the program is reached. Less than 10% overall improvement would be necessary to break even with the program cost.

Cost of Mass Lactating Cow Treatment

Depending on the predominant organism causing mastitis loss, antibiotic treatment may or may not be appropriate for all infected lactating cows. Cure rates for *Streptococcus agalactiae* may approach 90% whereas only a 30% cure rate may be expected for *Staphylococcus aureus* (6). Cows in the herd will have to be cultured to determine what organism is involved and how many cows are infected. From this point, the costs of a blitz treatment program can be calculated.

First, suppose the example herd had 50%

of the cows infected with *Streptococcus agalactiae* with a cure rate of 90%. Veterinary costs were estimated to be \$40/h for 4 h, milk price remained at \$12.50/cwt, and cost of treatment at \$1.00 per quarter. The program results are: \$1,350 milk discarded; \$480 cost of drugs; \$256 cost of culturing; \$160 consultant fees; \$2,246 total cost; \$43.60 increased production; 51 days to recover treatment costs. Contrasting this would be the situation with a similar infection with *Staphylococcus aureus*. Cure rate is 30%. The treatment program would cost the same; however, the value of the increased milk production would only be \$14.54 with 154 days necessary to recover the treatment cost. Based on these projections, the dairymen with *Streptococcus agalactiae* mastitis may want to undertake the treatment whereas the dairymen with the *Staphylococcus aureus* mastitis would be foolish to attempt therapy.

Program Listings

The mastitis loss program has eight variables entered into the calculator after the program is keyed into the calculator from magnetic card. These variables are the number of cows evaluated, production per cow per day, total number of cows in the herd, number of CMT 1, 2, and 3 quarters, and the price per pound of milk. Basically, the program calculates production per quarter and actual number of milking quarters. It also determines number of CMT 1, 2, and 3 quarters and amount of production lost per quarter. The total lost from each quarter classification finally is summed. The present situation then is compared to the goal situation, and savings that would be realized when the goal is attained are calculated. The program is in Table 1 using language of the Texas Instruments Programmable Calculator.

The program is for the Texas Instruments Programmable Calculator TI159. The calculator is prepared to record the program on a magnetic card by pressing the following keystrokes:

Step	Press
1	INV
2	2nd

Step	Press
3	FIX
4	RST
5	LRN
6	Enter the program from Table 1 step by step
7	LRN
8	1
9	2nd
10	Write
11	Insert card – displays “1”
12	Remove card
13	2
14	2nd
15	Write
16	Invert and insert card – displays “2”

To use the program on the magnetic card at a later time, use this sequence:

Step	Press
1	1
2	INV
3	2nd
4	Write
5	Enter card – display “1”
6	Remove card
7	2
8	INV
9	2nd
10	Write
11	Enter card – display “2”
12	Number of cows CMT evaluated
13	A
14	Number dry quarters in evaluated cows
15	B
16	Production per cow per day
17	C
18	Total cows in herd
19	D
20	Number CMT 1 quarters
21	2nd
22	A
23	Number CMT 2 quarters
24	2nd
25	B'
26	Number CMT 3 quarters
27	2nd
28	C'
29	Price per lb milk
30	2nd
31	D'
32	E – Starts program

Step	Press
33	Displays pounds milk lost per day
34	R/S
35	Displays value of milk lost per day
36	R/S
37	Displays value of milk lost per mo
38	R/S
39	Displays value of milk lost per cow per mo
40	R/S
41	Displays savings in pounds per day
42	R/S
43	Displays savings in dollars per day
44	R/S
45	Displays savings in dollars per mo
46	R/S
47	Displays savings in dollars per cow per mo

The towels, dip, and dry cow treatment program has seven variables to include number of cows in the herd, percent of cows in milk, calving interval in months, number of milkings per day, cost of towels per milking, cost per gallon of dip, and cost per each dry cow treatment. The program assumes two towels per milking and .002 gallons (.28 ounces) of dip per milking. Number of milkings per day is calculated from total number of cows, percent in milk, and number of milkings per

day. This is multiplied times the cost of towels per milking and 365 to give cost of the towels per year. From the calving interval, number of cows to be dry treated each year is calculated. Total quarters to treat is derived, and from that the cost of the total treatment is determined. For the teat dip cost, total milkings per year is calculated, and from that total the amount of dip used per year and its cost is calculated. The listing for this program is in Table 2.

The calculator is prepared to record on a magnetic card the Towel, Dip, and Dry Cow Treatment program by following these keystrokes:

Step	Press
1	INV
2	2nd
3	FIX
4	RST
5	LRN
6	Enter the program from Table 2 step by step
7	LRN
8	1
9	2nd
10	Write
11	Insert card — displays "1"

TABLE 1. Estimated subclinical mastitis losses and savings possible from control programs.

000	76	LBL	064	42	STO	128	30	30	192	13	13	256	43	RCL
001	11	A	065	06	06	129	55	÷	193	95	=	257	03	03
002	42	STO	066	43	RCL	130	43	RCL	194	42	STO	258	65	X
003	20	20	067	21	21	131	02	02	195	46	46	259	93	.
004	91	R/S	068	55	÷	132	95	=	196	43	RCL	260	00	0
005	76	LBL	069	43	RCL	133	65	X	197	46	46	261	02	2
006	12	B	070	02	02	134	43	RCL	198	99	PRT	262	95	=
007	42	STO	071	95	=	135	03	03	199	91	R/S	263	42	STO
008	21	21	072	42	STO	136	95	=	200	65	X	264	43	43
009	91	R/S	073	07	07	137	42	STO	201	43	RCL	265	43	RCL
010	76	LBL	074	43	RCL	138	11	11	202	33	33	266	04	04
011	13	C	075	06	06	139	43	RCL	203	95	=	267	55	÷
012	42	STO	076	65	X	140	04	04	204	99	PRT	268	93	.
013	22	22	077	43	RCL	141	55	÷	205	91	R/S	269	05	5
014	91	R/S	078	07	07	142	93	.	206	65	X	270	06	6
015	76	LBL	079	95	=	143	07	7	207	03	3	271	95	=
016	14	D	080	42	STO	144	02	2	208	00	0	272	75	-
017	42	STO	081	08	08	145	95	=	209	95	=	273	43	RCL
018	23	23	082	43	RCL	146	75	-	210	99	PRT	274	04	04
019	91	R/S	083	06	06	147	43	RCL	211	91	R/S	275	95	=
020	76	LBL	084	75	-	148	04	04	212	55	÷	276	65	X
021	16	A'	085	43	RCL	149	95	=	213	43	RCL	277	43	RCL
022	42	STO	086	08	08	150	65	X	214	23	23	278	43	43
023	29	29	087	95	=	151	43	RCL	215	95	=	279	95	=
024	91	R/S	088	42	STO	152	11	11	216	99	PRT	280	42	STO
025	76	LBL	089	03	03	153	95	=	217	91	R/S	281	44	44
026	17	B'	090	43	RCL	154	42	STO	218	43	RCL	282	43	RCL
027	42	STO	091	29	29	155	10	10	219	03	03	283	40	40
028	30	30	092	55	÷	156	43	RCL	220	65	X	284	85	+
029	91	R/S	093	43	RCL	157	31	31	221	93	.	285	43	RCL
030	76	LBL	094	02	02	158	55	÷	222	01	1	286	42	42
031	18	C'	095	95	=	159	43	RCL	223	95	=	287	85	+
032	42	STO	096	65	X	160	02	02	224	65	X	288	43	RCL
033	31	31	097	43	RCL	161	95	=	225	43	RCL	289	44	44
034	91	R/S	098	03	03	162	65	X	226	36	36	290	95	=
035	76	LBL	099	95	=	163	43	RCL	227	95	=	291	42	STO
036	19	D'	100	42	STO	164	03	03	228	42	STO	292	45	45
037	42	STO	101	01	01	165	95	=	229	40	40	293	43	RCL
038	33	33	102	43	RCL	166	42	STO	230	43	RCL	294	46	46
039	91	R/S	103	04	04	167	12	12	231	03	03	295	75	-
040	76	LBL	104	55	÷	168	43	RCL	232	65	X	296	43	RCL
041	15	E	105	93	.	169	04	04	233	93	.	297	45	45

042	43	RCL	106	08	8	170	55	÷	234	00	0	298	95	=
043	20	20	107	05	5	171	93	.	235	03	3	299	99	PRT
044	65	X	108	95	=	172	05	5	236	95	=	300	91	R/S
045	04	4	109	42	STO	173	06	6	237	42	STO	301	65	X
046	75	-	110	35	35	174	95	=	238	41	41	302	43	RCL
047	43	RCL	111	43	RCL	175	75	-	239	43	RCL	303	33	33
048	21	21	112	35	35	176	43	RCL	240	04	04	304	95	=
049	95	=	113	75	-	177	04	04	241	55	÷	305	99	PRT
050	42	STO	114	43	RCL	178	95	=	242	93	.	306	91	R/S
051	02	02	115	04	04	179	65	X	243	07	7	307	65	X
052	43	RCL	116	95	=	180	43	RCL	244	02	2	308	03	3
053	22	22	117	42	STO	181	12	12	245	95	=	309	00	0
054	55	÷	118	36	36	182	95	=	246	75	-	310	95	=
055	04	4	119	43	RCL	183	42	STO	247	43	RCL	311	99	PRT
056	95	=	120	36	36	184	13	13	248	04	04	312	91	R/S
057	42	STO	121	65	X	185	43	RCL	249	95	=	313	55	÷
058	04	04	122	43	RCL	186	09	09	250	65	X	314	43	RCL
059	43	RCL	123	01	01	187	85	+	251	43	RCL	315	23	23
060	23	23	124	95	=	188	43	RCL	252	41	41	316	95	=
061	65	X	125	42	STO	189	10	10	253	95	=	317	99	PRT
062	04	4	126	09	09	190	85	+	254	42	STO	318	91	R/S
063	95	=	127	43	RCL	191	43	RCL	255	42	42			

TABLE 2. Cost analysis for use of towels, teat dip, and dry cow treatment.

000	76	LBL	030	76	LBL	060	95	=	090	43	RCL	120	22	22
001	11	A	031	18	C'	061	42	STO	091	16	16	121	43	RCL
002	42	STO	032	42	STO	062	19	19	092	95	=	122	22	22
003	10	10	033	16	16	063	43	RCL	093	42	STO	123	99	PRT
004	91	R/S	034	91	R/S	064	19	19	094	21	21	124	91	R/S
005	76	LBL	035	76	LBL	065	65	X	095	43	RCL	125	43	RCL
006	12	B	036	15	E	066	03	3	096	21	21	126	20	20
007	42	STO	037	43	RCL	067	06	6	097	99	PRT	127	85	+
008	11	11	038	10	10	068	05	5	098	91	R/S	128	43	RCL
009	91	R/S	039	65	X	069	95	=	099	43	RCL	129	21	21
010	76	LBL	040	43	RCL	070	42	STO	100	18	18	130	85	+
011	13	C	041	11	11	071	20	20	101	65	X	131	43	RCL
012	42	STO	042	95	=	072	43	RCL	102	03	3	132	22	22
013	12	12	043	42	STO	073	20	20	103	00	0	133	95	=
014	91	R/S	044	17	17	074	99	PRT	104	95	=	134	42	STO
015	76	LBL	045	43	RCL	075	91	R/S	105	65	X	135	23	23
016	14	D	046	17	17	076	01	1	106	93	.	136	43	RCL
017	42	STO	047	65	X	077	02	2	107	00	0	137	23	23
018	13	13	048	43	RCL	078	55	÷	108	00	0	138	99	PRT
019	91	R/S	049	13	13	079	43	RCL	109	02	2	139	91	R/S
020	76	LBL	050	95	=	080	12	12	110	95	=	140	55	÷
021	16	A'	051	42	STO	081	95	=	111	65	X	141	01	1
022	42	STO	052	18	18	082	65	X	112	43	RCL	142	02	2
023	14	14	053	43	RCL	083	43	RCL	113	15	15	143	95	=
024	91	R/S	054	18	18	084	10	10	114	95	=	144	42	STO
025	76	LBL	055	65	X	085	95	=	115	65	X	145	24	24
026	17	B'	056	93	.	086	65	X	116	01	1	146	43	RCL
027	42	STO	057	00	0	087	04	4	117	02	2	147	24	24
028	15	15	058	00	0	088	95	=	118	95	=	148	99	PRT
029	91	R/S	059	05	5	089	65	X	119	42	STO	149	91	R/S

TABLE 3. Cost analysis for mass lactating cow antibiotic treatment.

000	76	LBL	037	42	STO	074	16	16	110	43	RCL	146	43	RCL
001	11	A	038	20	20	075	65	X	111	16	16	147	28	28
002	42	STO	039	91	R/S	076	08	8	112	65	X	148	55	÷
003	10	10	040	76	LBL	077	95	=	113	43	RCL	149	43	RCL
004	91	R/S	041	10	E'	078	65	X	114	13	13	150	27	27
005	76	LBL	042	42	STO	079	43	RCL	115	95	=	151	95	=
006	12	B	043	23	23	080	20	20	116	42	STO	152	42	STO
007	42	STO	044	91	R/S	081	95	=	117	25	25	153	29	29
008	11	11	045	76	LBL	082	42	STO	118	43	RCL	154	43	RCL
009	91	R/S	046	15	E	083	21	21	119	25	25	155	19	19
010	76	LBL	047	43	RCL	084	43	RCL	120	65	X	156	99	PRT
011	13	C	048	10	10	085	10	10	121	43	RCL	157	91	R/S
012	42	STO	049	65	X	086	75	-	122	12	12	158	43	RCL
013	12	12	050	43	RCL	087	01	1	123	95	=	159	21	21
014	91	R/S	051	14	14	088	95	=	124	42	STO	160	99	PRT
015	76	LBL	052	95	=	089	65	X	125	26	26	161	91	R/S
016	14	D	053	42	STO	090	02	2	126	65	X	162	43	RCL
017	42	STO	054	16	16	091	95	=	127	43	RCL	163	22	22
018	13	13	055	43	RCL	092	42	STO	128	18	18	164	99	PRT
019	91	R/S	056	16	16	093	30	30	129	95	=	165	91	R/S
020	76	LBL	057	65	X	094	43	RCL	130	42	STO	166	43	RCL
021	16	A'	058	43	RCL	095	30	30	131	27	27	167	24	24
022	42	STO	059	11	11	096	85	+	132	43	RCL	168	99	PRT
023	14	14	060	65	X	097	01	1	133	19	19	169	91	R/S
024	91	R/S	061	04	4	098	08	8	134	85	+	170	43	RCL
025	76	LBL	062	95	=	099	95	=	135	43	RCL	171	28	28
026	17	B'	063	42	STO	100	42	STO	136	21	21	172	99	PRT
027	42	STO	064	17	17	101	22	22	137	85	+	173	91	R/S
028	15	15	065	43	RCL	102	43	RCL	138	43	RCL	174	43	RCL
029	91	R/S	066	17	17	103	15	15	139	22	22	175	27	27
030	76	LBL	067	65	X	104	65	X	140	85	+	176	99	PRT
031	18	C'	068	43	RCL	105	43	RCL	141	43	RCL	177	91	R/S
032	42	STO	069	18	18	106	23	23	142	24	24	178	43	RCL
033	18	18	070	95	=	107	95	=	143	95	=	179	29	29
034	91	R/S	071	42	STO	108	42	STO	144	42	STO	180	99	PRT
035	76	LBL	072	19	19	109	24	24	145	28	28	181	91	R/S
036	19	D'	073	43	RCL									

The card may be used to run the program by following these keystrokes:

Step	Press
1	1
2	INV
3	2nd
4	Write
5	Enter card – display “1”
6	Number of cows in herd
7	A
8	Percent cows in milk (.00)
9	B
10	Calving interval in mo
11	C
12	Number of milkings per day
13	D
14	Cost per towel
15	2nd
16	A'
17	Cost per gallon dip
18	2nd
19	B'
20	Cost of single dry cow treatment
21	2nd
22	C'
23	E – Starts program
24	Displays cost of towels per yr
25	R/S
26	Displays cost of dip per yr
27	R/S
28	Displays cost of dry cow treatment per yr
29	R/S
30	Displays total cows per yr
31	R/S
32	Displays cost per mo

The mass lactating cow treatment analysis involved nine variables. Herd variables included number of cows in the herd, daily milk production per cow, and estimated milk production lost per day. Also required is the estimated percent cure rate and percent of infected cows. Hourly wage of the investigator and the hours spent on the case is entered as well as cost per drug treatment and the value per pound of milk. The program assumes all four quarters on each cow will be treated twice at 24-h

intervals and that milk will be discarded for four milkings after the first treatment. The cost of culturing assumes that each cow will be cultured. The cost estimates are \$8.00 for the first culture and \$2.00 for each additional culture. There is also a \$10.00 charge for antibiotic sensitivity testing. These values can be modified when the calculator is programmed to more closely reflect local conditions and costs. The program listing for this calculation is in Table 3.

To record the Mass Lactating Cow Treatment program on a magnetic card, the following keystrokes are used:

Step	Press
1	INV
2	2nd
3	FIX
4	RST
5	LRN
6	Enter program from Table 3
7	LRN
8	1
9	2nd
10	Write
11	Insert card – display “1”

In order to run the program, use the following keystrokes:

Step	Press
1	1
2	INV
3	2nd
4	Write
5	Enter card – display “1”
6	Number of cows in herd
7	A
8	Production in pounds per day
9	B
10	Lost production in pounds per day
11	C
12	Cure rate (.00)
13	D
14	Percent infected cows (.00)
15	2nd
16	A'
17	Hourly veterinary charge
18	2nd
19	B'
20	Value of milk per pound
21	2nd
22	C'
23	Cost of each drug treatment
24	2nd
25	D'
26	Veterinary time in hours
27	2nd
28	E'
29	E – Starts program
30	Displays value of discarded milk
31	R/S
32	Displays cost of drugs
33	R/S
34	Displays cost of culturing
35	R/S

Step	Press
36	Displays veterinary costs
37	R/S
38	Displays total cost
39	R/S
40	Value of increased production per day
41	R/S
42	Days to recover cost of treatment

CONCLUSION

Handheld programmable calculators can be used to calculate quickly subclinical mastitis loss from California Mastitis Test reactions. Once the magnitude of the loss has been estimated, savings from mastitis control programs can be determined. Cost for these control programs can be compared to estimated losses and cost-benefits ratio determined. Economic returns from mass lactating cow treatments can be estimated to determine if these treatments are cost effective. These programs are now being used to expose veterinary students to dairy economics in the classroom and on the farm. They easily could be used in extension educational programs for producers to illustrate the magnitude of milk lost from mastitis.

The future of these calculator programs is only limited by development of new programs which relate to dairy management. Linn and Spike have presented an excellent review of these calculators in which they describe the calculators, their advantages and disadvantages, and their applications (3). Any calculation which is used repeatedly or which requires many steps to reach an answer can be prepared for a programmed calculation. Calcula-

tions are curtailed only by the storage and memory capacity of the calculator. These programs will not replace such massive computer programs as the DHIA record system; however, they can utilize data from these systems to aid in making day-to-day management decisions.

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