

Program Description I

Program Title

BOWLING (GAME) SIMULATOR

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Program Description, Equations, Variables

This program realistically simulates the game of BOWLING. A bowler's average is used in the pin fall calculation. Therefore, a "200" bowler normally will score higher than a "150" bowler.

Splits, spares, and strikes are all possible. The only thing missing from real live action is the sound of pins being knocked down!!

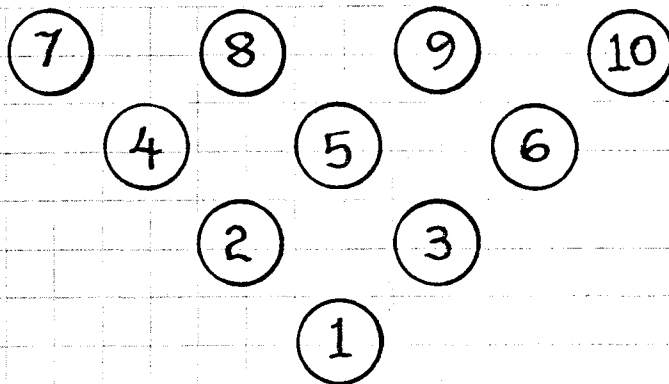
Operating Limits and Warnings

It is suggested that you use the SCORE SHEETS (see page 8) as you play. Unfortunately, this program has ONE LIMITATION: the 10th FRAME. IT IS POSSIBLE TO BOWL TOO FEW OR TOO MANY BALLS UNLESS YOU KEEP SCORE. (The calculator displays your "TOTAL" after the 2ND BALL. If you bowl a spare or 2 strikes, it doesn't tell you that you've got a 3RD BALL coming.)

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Sketch(es)



ALL TEN PINS ARE SHOWN
AS 7421360 ON THE
CALCULATOR.
("1" is the headpin)

Sample Problem(s)

BOWL TWO GAMES AS A 178-AVERAGE BOWLER.

Load both sides of the PROGRAM CARD.

Load both sides of the DATA CARD.

FOR AN EXPLANATION of all of
the possible outputs, refer to the page entitled:
"DATA CARD CONTENTS AND CHART" (page 5)

WITH THE EXCEPTION OF THE 10th FRAME, ALL FLASHING NUMBERS INDICATE YOUR SCORE (after initialization). (***)

Initialize. 178

f	A
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 $\rightarrow$ 178.***, 7421360.

Bowl first ball. $\boxed{A} \rightarrow 7421$ (SCORE 6)

Second ball. $\boxed{B} \rightarrow 0.00000, 10.***, 7421360.$

2ND FRAME. first ball. $\boxed{A} \rightarrow 610$ (SCORE 8)

Second ball

B

 $\rightarrow$ 0.00000, 28.***, 7421360.

6	8	7	3			7			3
18	35	48	68	95	115	135	165	188	208
(10)	(28)+7	(45)+3	(58)+10	+10+10+7	+10+7+3	(125)+10	+10+10+10	+10+10+3	+10+3+7
7421	610	421	74213.00	STRIKE	STRIKE	128	STRIKE	STRIKE	

SCORE for that frame. (Partial score)

— GTO PAGE 3 —

(USE THE SCORE CARD ON PAGE 2)

3RD FRAME. first ball. [A] → 421. (SCORE 7)

second ball. [B] → 0.00000, 45.*** 7421360.

4TH FRAME. first ball [A] → 74213.00 (SCORE 3). Bad luck!

second ball [B] → 0.00000, 58.*** 7421360.

5TH FRAME. first ball [A] → 0.000000000 STRIKE!

6TH FRAME. first ball [A] → 0.000000000 DOUBLE !!

7TH FRAME. first ball [A] → 128. (SCORE 7)

second ball [B] → 0.00000, 125*** 7421360.

8TH FRAME. first ball [A] → 0.000000000 STRIKE!

9TH FRAME. first ball [A] → 0.000000000 DOUBLE !!

TENTH FRAME PROCEDURES:

POSSIBILITY #1

[A] → STRIKE

[A] → ... SCORE

[RCL] [A]

if $R_A = 0$, last ball comes from [A]if $R_A \neq 0$, last ball comes from [B]

POSSIBILITY #2

[A] → anything (except STRIKE)

if [B] → 0.00000 (SPARE)

then Bowl another ball [A]

if [B] → N. (anything except SPARE)

then STOP.

10TH FRAME. first ball. [A] → 10.00000000 *** (see note), 0.00000000

second ball [A] → 201.*** (SCORE) [RCL] [A] → 74213.

 $R_A \neq 0$, so third ball [B] → 0.00000, 208*** 7421360.

FINAL SCORE IS 208. Very nice. Re-set and try again.

Re-set [E] → 7421360. etc. etc. (Use the score card below)

⊗	9	⊗	8	⊗	8	⊗	8	⊗	7	⊗	7	8
20	40	60	80	98	106	126	146	163	181			
10+7+3	(30)+10	+10+8+2	(10)+10	+10+8+0	(106)	(116)+10	+10+7+3	(156)+7	(173)+8			
STRIKE	7	STRIKE	6/0	STRIKE	74	74	STRIKE	742.	128			

NOTE: TENTH FRAME IS SHOWN BY 10.00000000*** OR 10.00*** OR 10.***
 THEN THE first ball results are displayed. Then, 10TH FRAME PROCEDURES.



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load sides 1 and 2 of PROGRAM CARD.			
2	Load sides 1 and 2 of DATA CARD.			
3	INITIALIZE. INPUT YOUR "AVERAGE" (LIMITS OF AVERAGE: between 75 and 250)	AVERAGE		
			f A	AVERAGE *** 7421360.
4	BOWL first ball.		A	PINS,
5	BOWL second ball		B	PINS KNOCKED DOWN -OR- 0.00000 - FOLLOWED BY - SCORE. *** 7421360.
6	If first ball is a STRIKE, next ball bowled uses			
7	Repeat STEPS 4 and 5 until the 10 th FRAME.			
8	Then follow TENTH FRAME PROCEDURES as described on page 3.			
9	After each frame is completed, you MAY check the frame number.		RCL 9	FRAME #
10	After each frame is completed, you MAY input a new seed. (any number between 0 and 1)	(seed)	STO 0	(seed)
11	When a game is completed, Re-set the calculator and pins -OR-		E	7421360.
11A	STEP 3 (with a new "AVERAGE")			

Data Card Contents

and Chart

DATA CARD 1		
Register Contents	Reg. #	
.8941273	0	(SEED)
0.	1	(SCORE)
7421.	2	7-4-2-1 pins standing; Score 6
74213.	3	DISPLAY → 74213.00 = 7 pins standing; Score 3
136.	4	1-3-6 pins standing; score 7
7421360.	5	(ALL "TEN" PINS)
10.	6	TEN-pin standing; score 9
7.	7	SEVEN-pin standing; score 9
421.	8	4-2-1 pins standing; score 7
0.	9	(FRAME COUNTER)
742.	S0	7-4-2 pins standing; score 7
610	S1	SIX-TEN pins standing; score 8
0.	S2	} STRIKE. DISPLAY → 0.000000000
0.	S3	
128.	S4	1-2-8 pins standing; score 7
74.	S5	FOUR-SEVEN pins standing; score 8
5.	S6	FIVE-pin standing; score 9
0.	S7	} STRIKE. DISPLAY → 0.000000000
0.	S8	
0.	S9	
LABEL 0 → 74.10		4-7-TEN SPLIT. = 3 pins standing; score 7.
LABEL 1 → 13.		1-3 pins standing; score 8
LABEL 5 → 4.10		4-TEN SPLIT. = 2 pins standing; score 8
LABEL 9 → 59.		5-9 pins standing; score 8
LABEL B (2ND BALL) → 0.00000 (SPARE) or N. (NUMBER OF PINS KNOCKED DOWN BY 2ND BALL.)		
then SCORE.*** and finally, 7421360. (ALL 10 PINS RE-SET)		

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	A f LBLA	31 25 11	BOWL FIRST BALL		GTO fb	22 31 12	
	f GSB 9"	31 22 09		2	f LBL 2	31 25 02	= 7421 =
	STD A	33 11			6	06	
	h F?O	35 71 00	} previous strikes?	060	GTO fb	22 31 12	
	f GSB 6"	31 22 06		1	f LBL 1	31 25 01	= 13 =
	h F?2	35 71 02			f GSB 1'	31 22 01	
	f GSB 7"	31 22 07			1	01	
8"	f LBL 8"	31 25 08	(LAST HALF OF STRIKE BALL)		3	03	
	RCL C	34 13			h RTN	35 22	
010	f x=0	31 51	} previous spare?	5	f LBL 5	31 25 05	= 4.10 = SPLIT
	f GSB 5"	31 22 05			DSP 2	23 02	
	1	01			h SF 1	35 51 01	SF 1 for SPLIT
	STD + 9	33 61 09	Increment frame counter and CHECK PRINT 10.00000000 or 10.00 on 10. If this is the last frame,		f GSB 1'	31 22 01	
	RCL 6	34 06		070	4	04	
	RCL 9	34 09			.	83	
	g x=y	32 51			1	01	
	f -x-	31 84			h RTN	35 22	
	g x>y	32 81		0	f LBL 0	31 25 00	= 74.10 = SPLIT
	GTO 2"	22 02			DSP 2	23 02	
020	f GSB 5"	31 22 05			h SF 1	35 51 01	SF 1 for SPLIT
	RCL A	34 11			f GSB 4'	31 22 04	
	R/S	84			7	07	
2"	f LBL 2"	31 25 02	END OF TENTH FRAME		4	04	
	h CF 0	35 61 00		080	.	83	
	h CF 2	35 61 02			1	01	
	1	01			h RTN	35 22	
	2	02	x=y if 2 STRIKES were bowled in 10th FRAME	9	f LBL 9	31 25 09	= 59 =
	g x=y	32 51			f GSB 1'	31 22 01	
	f GSB 5"	31 22 05			5	05	
030	DSP 0	23 00			9	09	
	RCL 1	34 01			h RTN	35 22	
	h SPACE	35 84		fc	f LBL C	32 25 13	USE SECONDARY REG.
	f -x-	31 84			3	03	
	R/S	84		090	h RCL I	35 34	
7"	f LBL 7"	31 25 07	SCORE LAST STRIKE		RCL 6	34 06	
	h F?O	35 71 00			-	51	
	f GSB 5"	31 22 05			h STD I	35 33	
	h SF 0	35 51 00			g x=y	32 51	
	GTO 5"	22 05			GTO 3'	22 03	
040	6" f LBL 6"	31 25 06	SCORE 2ND STRIKE		2	02	
	h CF 0	35 61 00			h x=y	35 52	
5"	f LBL 5"	31 25 05	SCORE LAST BALL		g x=y	32 51	
	RCL E	34 15			GTO 3'	22 03	
	STD C	33 13		100	7	07	
	STD + 1	33 61 01			g x=y	32 71	
	h RTN	35 22			GTO 3'	22 03	
9"	f LBL 9"	31 25 09	FIRST BALL SUBROUTINE		f P=S	31 42	
	9	09			f GSB (i)	31 22 24	
	g GSB fd	32 22 14			f P=S	31 42	
050	h STD I	35 33	IF x>y GTO fc and use secondary registers otherwise GTO (i)		h RTN	35 22	
	g x>y	32 81		6'	f LBL 6'	31 25 06	= 10 = 5 =
	GTO fc	22 31 13		7	f LBL 7	31 25 07	= 7 =
	GTO (i)	22 24			9	09	
3	f LBL 3	31 25 03	= 74213.00 =	110	GTO fb	22 31 12	
	DSP 2	23 02		1'	f LBL 1'	31 25 01	= 610 =
	3	03		5'	f LBL 5'	31 25 05	= 74 =

REGISTERS

0 (SEED)	1 SCORE	2 7421	3 74213	4 136	5 7421360	6 10	7 7	8 421	9 FRAME COUNTER	
S0 742	S1 610	S2 0.	S3 0.	S4 128	S5 74	S6 5	S7 0.	S8 0.	S9 0.	
A TEMPORARY PINS REMAINING		B $\left(\frac{AVG}{6} - 9\right) + 5$ or $+0$		C SPARE ?		D NEXT-TO-LAST BALL		E LAST BALL		I USED

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
	8	08			fx=0	31 51	
	GTO fb	22 31 12		170	RIS	84	
0'	f LBL 0'	31 25 00	==742==		g GSB fd	32 22 14	There is no "2ND BALL" on a STRIKE !!
4'	f LBL 4'	31 25 04	==136== 128==		h F?1	35 71 01	SPLIT ?
8	f LBL 8	31 25 08	==421==		f GSB 1"	31 22 01	
	7	07			f RND	31 24	
	GTO fb	22 31 12			g GSB fb	32 22 12	
120 3'	f LBL 3'	31 25 03	=STRIKE=		h R↓	35 53	
	RCL 6	34 06			RCL 6	34 06	If x > (10-R _D), GTO 2
	h STO I	35 33			RCL D	34 14	otherwise STORE in R _e
	g GSB fb	32 22 12			-	51	and show SPARE
	h F?2	35 71 02		180	g x>y	32 81	
	f GSB 7"	31 22 07		181	GTO 2	22 02	
	h SF2	35 51 02		183	STO +1	33 61 01	ADD STEP 182: STD E 33 15
	DSP 9	23 09			h F?0	35 71 00	
	CLX	44			f GSB 6"	31 22 06	
	STD A	33 11			DSP 5	23 05	
130	GTO 8"	22 08			CLX	44	
fb	g LBL b	32 25 12	ADJUST PIN COUNT		h PAUSE	35 72	
	RCL E	34 15			DSP 0	23 00	
	STD D	33 14		190	GTO 3"	22 03	
	h R↓	35 53		1"	f LBL 1"	31 25 01	DIVIDE FOR SPLIT
	STD E	33 15			S	05	
	RCL (i)	34 24			÷	81	
	h RTN	35 22			h CF1	35 61 01	
fa	g LBL a	32 25 11	INITIALIZATION		h RTN	35 22	
	h F?3	35 71 03		2"	f LBL 2"	31 25 02	"OPEN" FRAME
140	h F?3	35 71 03	"Error"		h x≠y	35 52	
	GTO C	22 13			STD +1	33 61 01	
	DSP 0	23 00			h PAUSE	35 72	DISPLAY # OF PINS KNOCKED DOWN BY 2ND BALL.
	f -x-	31 84		200	-	51	
	6	06			ENT ↑	41	
	÷	81			h F?0	35 71 00	
	2	02			f GSB 6"	31 22 06	
	7	07			h R↓	35 53	
	h x≠y	35 52	IF m ≤ 27, GTO fa'	3"	f LBL 3"	31 25 03	FINISH 2ND BALL
	g x≠y	32 71	IF m > 27, ADD 5		STD C	33 13	
150	GTO fa'	22 31 11			RCL 1	34 01	
	5	05			f -x-	31 84	
	+	61		4"	f LBL 4"	31 25 04	DISPLAY ALL TEN PINS
fa'	g LBL a'	32 25 11	fa CONTINUED	210	RCL 5	34 05	
	9	09			h RTN	35 22	
	-	51		fd	g LBL d	32 25 14	RANDOM NO. GENERATOR
	STD B	33 12	ADD "m" to the FRAC already contained in R _o		DSP 0	23 00	
	STD +0	33 61 00			RCL 0	34 00	
E	f LBL E	31 25 15	RE-SET		9	09	
	STD C	33 13			9	09	
160	h CF0	35 61 00	NOTE: X CANNOT = 0 for RE-SETTING R _c		7	07	
	h CF1	35 61 01			X	71	
	h CF2	35 61 02			g FRAC	32 83	
	0	00		220	STD 0	33 00	
	STD 1	33 01			RCL B	34 12	
	STD 9	33 09			X	71	
	STD E	33 15			f INT	31 83	
	GTO 4"	22 04			h RTN	35 22	
B	f LBL B	31 25 12	SECOND BALL				

LABELS				FLAGS		SET STATUS		
A 1ST BALL	B 2ND BALL	C	D	E RE-SET	0 2ND STRIKE	FLAGS		DISP
a INITIAL	b ADJUST PIN COUNT	c SECONDARY REGISTERS	d RANDOM # GENERATOR	e	1 SPLIT	ON OFF	TRIG	FIX
0 USED	1 USED	2 USED	3 USED	4 USED	2 1st STRIKE	0 ☐ ☒	DEG ☒	FIX ☒
5 USED	6 USED	7 USED	8 USED	9 USED	3 AVG ENTERED?	1 ☐ ☒	GRAD ☐	SCI ☐
						2 ☐ ☒	RAD ☐	ENG ☐
						3 ☐ ☒		n 3

