



# **PROBABILITY HANDICAPPING DEVICE – 1**

## **SPRINT RACES**

**(7½ Furlongs or Less)**

**A comprehensive thoroughbred  
handicapping system for the personal computer**

**from JOE COMPUTER**

PROBABILITY HANDICAPPING DEVICE 1:  
THOROUGHBRED SPRINT RACES

USERS MANUAL

REV. A

WRITTEN BY: M.R. DOWNING

DEDICATED TO: H.M. DOWNING

© COPYRIGHT 1980, JOE COMPUTER

All rights reserved. Reproduction or use without express permission is prohibited. No patent liability is assumed with respect to the use of the information contained herein. While every precaution has been taken in the preparation of this manual, Joe Computer assumes no responsibility for errors or omissions. Neither is any liability assumed for damage resulting from the use of the information contained herein.

### DISCLAIMER

The products comprising the computer program "PROBABILITY HANDICAPPING DEVICE-1" and the attendant documentation are intended solely for the fun and enjoyment of the computer hobbyist. JOE COMPUTER hereby disclaims any and all warranties regarding such products in regard to their use for any other purpose. In no event shall JOE COMPUTER be liable for any damages resulting from use of these products or of any portion thereof or of any data or information derived thereof. Use of these products by those who anticipate economic gain as a result thereof, shall be entirely at their own risk.

## TABLE OF CONTENTS

INTRODUCTION . . . . .	i
CHAPTER 1: Entering Past Performance Data . . . . .	1
CHAPTER 2: Overlay Betting and Money Management . . . . .	10
CHAPTER 3: Archive . . . . .	15
APPENDIX . . . . .	16



## INTRODUCTION

In the last few years, mainly due to the proliferation of computers and the development of a branch of mathematics called "game theory", several significant discoveries about thoroughbred handicapping have been made. They have gone relatively unnoticed.

PHD-1 represents a coalescing of several of these discoveries and techniques in the form of a computer program for use on inexpensive personal computers. This allows the horse-player who has little or no experience with computers to drop in at his local Radio Shack, computer, or department store, layout a few hundred dollars for a home computer, and be handicapping with PHD-1 within a couple of hours. PHD-1 also allows the experienced computerist the opportunity to take advantage of these new handicapping advancements and become a winner at the track.

Probability handicapping with a computer probably has its early roots in a book written by Burton Fabricand in 1965 called Horse Sense. Dr. fabricand did an extensive statistical study of horse racing and concluded that overlays do occur in thoroughbred racing and, more important, are predictable using statistical techniques.<sup>1</sup>

The overlay is the basis for the winning edge in PHD-1. Because the odds on a particular horse in a race are set at the whim of the crowd, sometimes the odds on the horse are higher than they ought to be based on the probability that particular horse has of winning the race. By providing the user with an accurate odds line the night before a race, PHD-1 and the home computer are a powerful team which can yield a consistent advantage when used properly.

## DOES IT WORK?

This question can only be answered through the application of PHD-1 to a large number of races over a period of years. We can state that in one study done on 87 consecutive sprint races incorporating the last half of the 1979 Del Mar season coupled with the first half of the 1979 Santa Anita Oaktree meet PHD-1 showed a phenomenal ability to predict win probability (see graph 2 in appendix) and showed an amazing average 50% advantage, winning 21% of the bets made. This means that for every \$1.00 wagered on a predicted overlay the user won \$0.50. This is an unheard of return for this

<sup>1</sup>

Fabricand, Burton P., HORSE SENSE, David McCay Company, Inc. New York 1965.

type of handicapping device. In fact it was so high we considered doing other studies to find one with a lower return to publish because we were afraid no one would believe us. This is why a printout of the entire study is reproduced in the appendix. If you have the forms for that period you can repeat the study yourself to verify our results. Incidentally, those races were used only because we had complete sets of those forms, not because of any a priori knowledge that they would do well. They also were not incorporated in the statistics used to develop PHD-1.

### ARCHIVE

This does not mean that you should run to your local track and begin wildly betting using PHD-1. Be conservative. An 87 race work-out is certainly not conclusive. Do your own work-out using data for your track until you build up confidence in your ability to use PHD-1. That is the purpose of the ARCHIVE subroutine. This unique feature which is embedded in the PHD-1 Basic code allows the user to store the output from PHD-1 in efficiently packed variable length records. The user can then write his own analysis routines to test PHD-1's ability at his local track. In fact, the printout in the appendix was done exactly that way. The track odds and winning horse's post position were put into a data array in the analysis program and the data tape containing PHD-1's output was used as an input. The analysis program then produced the listing. See the chapter on ARCHIVE.

The following chapters explain how to load PHD-1, enter data, and interpret the output.

Remember that PHD-1 is optimized for sprint races only ( $7\frac{1}{2}$  furlongs or less). Do not use PHD-1 for route races. PHD-2 will cover those. Remember also that PHD-1 is an overlay betting system. Its primary objective is to calculate the win probability of a horse. This means that you will pass up a lot of picks because the odds are too low. It also means that you will lose more bets than you win, but because of the high odds on your winning picks you should win more money than you lose. If you follow the advice in the chapter on overlays and money management you will reduce the probability of tapping out to about 10%. Therefore, it is important to read the instructions and practice at home before attacking the track.

GOOD LUCK!!!

## CHAPTER 1: ENTERING PAST PERFORMANCE DATA

PHD-1 requires horses with an adequate number of past races shown in the form. Don't use maiden races unless all the horses in the race have at least 2 or 3 previous races. Some experimentation on your part will be necessary to determine what maiden races you feel comfortable with. Remember that PHD-1 is optimized for sprint races ( $7\frac{1}{2}$  furlongs or less).

If a horse was disqualified, fell down, or lost his rider etc. go to the race prior to that one.

It is easier to explain the data entry by example. The race we will use was one run at Del Mar on August 24, 1979. It appeared in the Daily Racing Form as shown on the following page.

Follow along with your own computer and see if you get the same results.

After typing "RUN", the first question appears:

### HOW MANY HORSES IN THIS RACE? T

It is suggested that you number the horses consecutively with a marking pen as shown in the reprint from the racing form. This helps you keep track of how many horses are in the race, and their post position number.

In our example there are 5 horses in the race. So the response is:

5 (ENTER)\*

The next question is:

### ENTER THE HORSE'S NAME (OPTIONAL) ?

It is not necessary to enter anything in response. If you don't want to enter a name simply press the "Enter" key.

It is suggested that you use a name or mnemonic to help keep track of the horses. This can be a name up to 10 characters in length. In our example the first horse is Absent Minded.

The Daily Racing Form past performance for Absent Minded is shown on the top of the next page:

\*Note: (ENTER) refers to pressing the ENTER key.

TNote: Depending on the type of computer you are using, the screen prompt formats may be different from those shown, but the data entered is the same.



# 3rd Del Mar

2



6 FURLONGS. (1.0735) CLASSIFIED ALLOWANCE. Purse \$20,000. 3-year-olds and upward which are non-winners of \$13,000 twice since April 8. Weights, 3-year-olds, 117 lbs.; older, 122 lbs. Non-winners of a race of \$20,000 since April 1, allowed 3 lbs.; of a race of \$13,000 since June 15, 5 lbs.; of such a race since April 8, 8 lbs. (Claiming races not considered.)

## Absent Minded

Own.—Heardsdale

1

114

2Jun79-10Crc 6f :224 :454 1:173ft 43 116  
11Sep78-8Dmr 1 1/2 :474 1:11 1:422ft 5 114  
2Sep78-5Dmr 1 1/2 :464 1:11 1:50 fm 6 114  
21Aug78-8Dmr 7 1/2 :23 :4611:291fm 9 115  
1Jly78-7Hol 1 1/2 :4911:39 2:152fm 5 114  
10Jun78-8GG 1 1/2 :4521:0931:413fm \*2 116  
3Jun78-7Hol 1 1/2 :46 1:10 1:41 fm 2 114  
14May78-7Hol 1 1/2 :4641:1041:412fm 17 114  
8Nov77-1Aqu 7f :233 :452 1:232sy 16 115  
22Oct77-6Med 1 1/2 :5041:4222:21 sf 37 110

Aug 11 SLR tr. 1 1/4 ft 1:14 h

Aug 11 SLR tr. 1 1/4 ft 1:02 h

Ch. g. 7, by Arts and Letters—Sweet Folly, by Tom Fool

Br.—Greentree Stud Inc (Ky)

Tr.—Heard Thomas H Jr

1979 1 0 0 0 \$90  
1978 7 1 2 0 \$27,175  
Turf 24 4 4 0 \$102,700

910 910 910 912 Crews W7 Alw 86 JungleAdm,Evsboy,SwingingKnight 9  
816 891 911 913 CstnedM3 Escnddo H 84 Bywyofchgo,BickSlphr ArondWGe 9  
917 811 78 23 Castaneda M6 Alw 90 BickSlphr,AbsntMndd,HmbiHowrd 10  
613 57 54 1/2 44 1/2 Diaz A L5 Alw 91 AlwaysGallnt,Cpt Don,Eivistobueno 6  
59 1/2 53 3 1/2 13 Castaneda M3 Alw 78 AbsntMinded,GoldStndrd,Brtllsvill 6  
1041104010221014 Vlenzuell7 Oakland H 62 Gallapiat, Lino, All Hope 10  
612 58 54 1/2 45 Castaneda M2 Alw 89 Life's Hope,JuanDon,AlwaysGallnt 6  
67 1/2 55 44 2nk Castaneda M6 Alw 92 AllHope,AbsntMinded,BoldImpuls 9  
411 412 515 516 DiNicola B2 Alw 68 Jaipur'sGem,Patriot'sDrem,Pimem 5  
1283105312151217 DiNicola B8 Nelson H 80 Dragset, Stir The Embers, Oilfield 12

## \*Star Prince II

Own.—Malibu Vly Fms & Smok Stb

2

122

15Apr79-8Hol 6f :222 :444 1:082ft \*9-5 125  
11Apr79—Disqualified and placed sixth  
8Apr79-5SA a6f :212 :4411:133fm\*4-5 124  
18Mar79-5SA 6f :212 :44 1:161sy \*9-5 124  
13Aug78-5Perak (Malaysia) a5f 1:03 gd 147  
6Aug78-5Perak (Malaysia) a5f 1:023gd 144  
25Jun78-5Selanger (Mal) a6f 1:11 gd 124  
18Jun78-5Selanger (Mal) a6f 1:10 gd 123  
2Apr78-4BukitTimah (Sing) a7f 1:271gd 110  
19Feb78-5BukitTimah (Sing) a6f 1:134gd 120  
15Aug77-40stend (Belgium) a1 1:372fm 7 128

Aug 21 Dmr 4 ft :44 h

Aug 15 Dmr 6 ft 1:10 h

Ch. g. 5, by Realm—Welsh Star, by Welsh Abbot

Br.—Mount Coote Stud (Ire)

Tr.—French Neil

1979 3 1 1 0 \$30,000  
1978 6 6 0 0 \$69,358  
Turf 18 10 1 2 \$99,129

44 44 1/2 44 1/2 44 1/2 Pincay L Jr1 L A H 91 Hwkn'sSpcl,WhtRmmr,Whtsyorplsr 6  
11 12 1/2 11 11 1/2 Pincay L Jr2 Hcp0 91 StrPrince,AroundWeGo,LinstrHous 8  
22 2 1/2 2 1/2 23 Pincay L Jr6 Hcp0 86 BckByBet,StrPrince,LeinsterHouse 7  
13 13 1/2 ----- Sultan's Gold Vase H Star Prince, Jubilation III, Jacado 15  
16 ----- Hcp Trl StrPrnc,DgonCmmd,HymbiHryst 18  
1 1 1/2 ----- HMAgung Gold Cup H StarPrince,PahangIII,PulauMutiar 12  
1 no ----- Hcp Trl Star Prince, Pahang III, Smile 16  
1 nk ----- Class I Div 1 H StrPrince,GntlmnAgrmnt,GoldnWy 11  
1 1 ----- Class I Div 2 H Star Prince,SoonHong,BravePanter 8  
47 1/2 VaninS Px Chlr d'Stuers H Vanian, Ziethen, Amphioxus 13

## Bold L. B. \*

Own.—Dazoc Stable Inc

3

119

4Aug79-8Dmr 6f :212 :433 1:082ft 13 120  
12Jly79-7AKs 5 1/2 :214 :443 1:034gd 8-5 120  
21Jun79-7AKs 6f :22 :441 1:10 ft \*9-5 122  
30Mar79-90P 6f :214 :452 1:112sy 8 116  
23Mar79-80P 6f :222 :462 1:122ft 8-5 113  
13Mar79-70P 6f :214 :45 1:111ft 3 119  
3Mar79-90P 6f :213 :444 1:094ft 5e115  
24Feb79-90P 6f :224 :47 1:124sy 23e119  
11Feb79-9FG 6f :22 :454 1:103ft \*2-3 122  
6Jly78-8AKs 6f :222 :451 1:111sy \*4-5 122

Aug 21 Dmr 4 ft :45 h

Aug 13 Dmr 6 ft 1:10 h

Ch. c. 4, by Bold Bidder—Pretty Fancy, by Swaps

Br.—Firman Pamela H (Ky)

Tr.—Brandt Louis W

1979 9 3 1 0 \$44,556  
1978 4 3 0 0 \$49,780

41 1/2 7 1/2 7 1/2 6 1/4 Lively J4 B Crosby H 82 Syncopate,WhiteRmmr,FleetTwist 7  
22 2nd 12 14 1/2 Lively J3 Speed H 91 Bold L. B., Amadevil, Beau Blade 6  
3 1/2 11 14 1 1/2 Melancon L2 Alw 87 Bold L. B., Siron, Roman Zipper 7  
1 1/2 2nd 4 1/2 4 1/2 Melancon L7 Hcp0 80 Last Buzz, Little Reb, Amadevil 7  
2 1/2 1 1/2 1 1/2 Melancon L3 Alw 83 BoldL.B.,BrazendBold,DelwrePunch 7  
1 1st 2nd 2nd Melancon L1 Alw 89 PovrtyBoy,BoldL.B.,WshngtnCnty 10  
4 1/2 44 813 822 Whited D E6 Hcp0 74 RymondErl,CbriniGren,ChynnNtion 8  
1 1st 2nd 46 89 1/2 Lively J2 Hcp0 71 CheynnNtion,CbriniGren,RymondErl 8  
42 1/2 52 5 1/2 5 1/2 Lively J2 Pelleteri H 87 CbriniGreen,OilPtchPpp,PetWrrior 6  
1 1/2 11 13 15 Lively J2 Alw 81 Bold L. B., HonkenHenry,Old'nBold 8

## No No

Own.—Bacharach B

4

117

4Aug79-8Dmr 6f :212 :433 1:082ft 4 116  
13Jun79-6Hol 7f :22 :44 1:204ft 5 117  
19May79-6Hol 6f :221 :443 1:082ft 2 117  
3May79-8Hol 6f :221 :451 1:091ft 2 115  
8Apr79-5SA a6f :212 :4411:133fm 3 114  
25Mar79-6SA 6f :212 :44 1:083ft 4 114  
4Mar79-6SA 7f :22 :441 1:212ft \*6-5 114  
18Feb79-6SA 1 :452 1:10 1:343ft 13 113  
13Jan79-7SA 6 1/2 :214 :441 1:143ft 2 120  
26Dec78-8SA 6f :212 :434 1:083ft 21 117

Aug 21 Dmr 3 ft :33 h

Aug 17 Dmr 4 ft :50 h

B. g. 4, by T V Commercial—Cuba Bound, by Sunrise Flight

Br.—Marydel Farm (Md)

Tr.—Wingfield Robert

1979 9 1 3 2 \$48,700  
1978 7 2 1 0 \$51,245  
Turf 1 0 0 0 \$3,000

31 54 55 1/2 59 1/2 McHrgDG2 BCrosbyH 86 Syncopate,WhiteRmmr,FleetTwist 7  
1 1st 1st 2nd 2 1/2 McHargue DG3 Hcp0 94 Arachnoid, No No, Syncopate 5  
2 1/2 1 1 13 15 1/2 McHargue D G4 Alw 95 No No, Maheras, Double Discount 6  
1 1st 2nd 2nd 2 1/2 McHargue D G6 Alw 89 Little Reb, No No, B. W. Turner 7  
32 34 1/2 43 4 1/2 Shoemaker W5 Hcp0 86 StrPrince,AroundWeGo,LinstrHous 8  
4 1/2 34 43 32 3 1/2 Cordero A Jr7 Alw 94 Whatsyourpleasure, Maheras,NoNo 7  
1 1/2 12 11 2 1/2 Cordero A Jr7 Alw 95 Windy's Duke, No No, Don F 7  
1 1/2 1st 32 3 1/2 Cordero A Jr4 Alw 91 StarSpangled,TrueStatement,NoNo 6  
1 1st 1st 3 1/2 4 1/2 McHargue D G3 Alw 89 Baldski, Harry's Love, Little Joker 8  
1 1/2 3 1/2 6 7 10 CstndM3 PalosVerdH 86 Little Reb,CrashProgram,Bad'NBig 9

## Cool Frenchy

Own.—Lichlyter Dr or Mrs F E

5

122

12Aug79-7Dmr 1 1/2 :4711:1131:431fm 23 116  
4Aug79-8Dmr 6f :212 :433 1:082ft 13 115  
4Aug79—Lost Irons  
18Jly79-8Hol 6f :212 :433 1:084ft 26 111  
23Jun79-8Hol 7f :212 :433 1:211ft 13 113  
15Jun79-7Hol 6f :22 :443 1:09 ft 27 114  
8Jun79-7Hol 6f :221 :454 1:101ft 10 120  
26May79-7Hol 6f :22 :442 1:092ft 3 120  
4May79-8Hol 6f :214 :443 1:092ft 10 120  
25Apr79-3Hol 6f :223 :451 1:094ft 33 116  
3Apr79-7GG 6f :214 :443 1:091ft 5 120

Aug 20 Dmr 4 ft :49 h

Jly 30 Dmr 5 ft 1:01 h

Dk. b. or br. c. 4, by French Policy—Cool Persian, by Persia

Br.—Lichlyter Mary Ada (Cal)

Tr.—Lichlyter Mary A

1979 13 4 3 0 \$61,305  
1978 6 1 1 0 \$4,229  
Turf 1 0 0 0

2 1/2 66 6 11 — OrtegLE1 B Crosby H — Syncopate,WhiteRmmr,FleetTwist 7  
2nd 12 13 1 1/2 OrtegLE9 Hol Exp H 93 Cool Frenchy, He's Dewan,Infusive 9  
1 1st 2nd 524 527 OrtegLE3 Trpl Bnd H 66 WhiteRammer,Arachnoid,Bad'NBig 5  
1 1 1 1 1 1/2 OrtegLE3 Alw 92 Cool Frenchy,Foyt'sAck,FleetTwist 8  
1 1 1 1 1 1/2 OrtegLE4 Alw 82 Someoneoblie,StandPat,Nola'sGuy 6  
1 1 1 1 1 1/2 OrtegLE5 Alw 90 Cool Frenchy, Palsam, Lama 7  
1 1 1 1 1 1/2 OrtegLE6 Alw 88 Somonobli,CoolFrncy,3RoylHoofr 6  
1 1 1 1 1 1/2 Gonzalez C4 Alw 83 Sponge, Wickerr, Tete a Tete 8  
1 1 1 1 1 1/2 Sanchez F4 Alw 92 SportngEvt ColFrncy MycMrln 12

Last distance	4 points of call		Number of lengths		Last post Class		Starts, 1sts and 2nds	
	Ch. g. 7, by Arts and Letters—Sweet Folly, by Tom Fool		Br.—Greentree Stud Inc (Ky)		Tr.—Heard Thomas H Jr			
Absent Minded	Own.—Heardsdale	114	910	910	910	912	1979	1 0 0 0 \$90
2Jun79-10Crc	6½f :224 :454 1:173f	43 116	816	891	911	913	1978	7 1 2 0 \$27,175
11Sep78-8Dmr	1½ :474 1:11 1:422f	51 114	917	811	78	21	Turf	24 4 4 0 \$182,700
2Sep78-5Dmr	1½ :464 1:11 1:50 fm	61 114	613	57	54½	44½	Alw 86	JungleAdm,Evsboy,SwingingKnight 9
21Aug78-8Dmr	7½f :23 :461 1:291fm	91 115	Castaneda M6	Escnddo H	84	Bywyofchcgo,BickSlphr,ArondWGo 9	Alw 90	BickSlphr,AbsntMndd,HmbIHowrd 10
1Jly78-7Hol	1½ :491 1:39 2:152fm	51 114	Diaz A L5	Alw 91	AlwaysGallnt,Cpt.Don,EIVistobueno 6	Alw 78	AbsentMinded,GoldStndrd,BrtIsvill 6	10
10Jun78-8GG	1½ :452 1:093 1:413fm	*2 116	1041	1040	1022	1014	Vlenzuell7	Oakland H 62 Gallapiat. Lino. All Hope

Figure 1

Therefore, the following is entered:

AB (ENTER)

The screen will prompt the following question:

ENTER THE DISTANCE OF THE LAST RACE  
IN FURLONGS: (IF 1 MILE OR MORE  
ENTER "9" IF NONE PRESS ENTER) ?

Remember to round off. 6½ furlongs is entered as 7, 7½ as 8, etc. A 9 is entered for route races as a convenient number to speed up entry.

If the horse has no previous race simply press the "Enter" key and data entry for the horse will be terminated.

The first horse, Absent Minded ran 6½ furlongs in his last race, (see figure 1).

The following response is entered:

7 (ENTER)

The next question prompted is:

ENTER THE 4 POINTS OF CALL IN THE LAST RACE: ?

Some version of the racing form have 5 points of call, some 4. What is required are the last 4 points of call. These entries, as all multiple entry questions, are separated by commas.

The 4 points of call are circled in figure 1.

The entry is made as follows:

9,9,9,9 (ENTER)

ENTERING PAST PERFORMANCE DATA

After a short pause the next question appears:

ENTER THE NUMBER OF LENGTHS: (THIS HORSE  
WON OR LOST BY IN LAST RACE) ?

This is the superscript number found after the 4th point of call. Remember to round off; i.e.  $1\frac{1}{2}$  is entered as 2, "hd" (head) or "no" (nose) is entered as 0.

The horse in our example lost by 12 lengths.

Our entry is:

12 (ENTER)

The next question prompted is:

ENTER THE POST POSITION IN LAST RACE: ?

This number will be found in different locations in the past performance depending on the version you have. Check the guide in your version of the form to find the proper value. In our version it is found after the jockey's name.

Thus, our entry is:

7 (ENTER)

Now we come to class. The question is:

WAS THIS HORSE'S LAST RACE A MAIDEN,  
CLAIMING, ALLOWANCE, STAKES, OR HANDICAP  
RACE (ENTER M,C,A,S,H, OR N FOR NONE) ?

The class is the most difficult entry to translate from the past performance. The following summary and examples show how to discern the class:

MAIDEN: A maiden race is indicated with a "M" followed by a claiming value (i.e. M2500) or the mnemonic "mdn".

CLAIMING: A claiming race is indicated by a claiming price only.

ALLOWANCE: An allowance race is indicated by the mnemonic "alw".

STAKES: A stakes race is indicated with the name of the race (i.e. Cinderella, Nursery, etc.).

**HANDICAP:** A handicap race is also indicated with the name of the race. However, the name is followed by the letter "H". (i.e. B. Crosby H).

The following horse's last race was a maiden race:

### Red Bee Maxene

B. f. 3, by Prince Union—Aprobacion, by Sideral  
 Br.—Red Bee Ranch (Cal) 1979 6 M 1 0 \$2,850  
 Tr.—Whittingham Michael \$20,000 1978 0 M 0 0  
 Own.—Red Bee Ranch 117  
 26Jly79-3Dmr 6f :223 :461 1:11 ft 55 116 521 521 66 783 CespedesR8 @M20000 74 VerbtimBelle,BostonBurd,L,Strind 12  
 11Jly79-2Hol 6f :221 :45 1:101ft 31 116 873 88 9111019 Toro F8 @M20000 67 PreciousPlaza,SistersGlmor,Leven 12  
 23May79-2Hol 7f :214 :443 1:23 ft 43 114 423 33 563 713 McCrrn CJ10 @M25000 71 NiceHonor,Lottiel,Jeffrs,OvrthDII 12

The following horse's last race was a claiming race:

Own.—R H O Stable & Noren 120 Tr.—Sinne Gerald M \$12,500 1978 6 M 0 0 \$4,775  
 4Aug79-4Bmf 1 :461 1:111 1:373ft 63 1135 853 78 753 733 Hanna M A1 14000 77 GoodBrgin,ARoundTuitt,ClinchPie 10  
 24Jly79-12Bmf 1 1/2 :473 1:124 1:444ft 43 1155 55 55 42 433 Hanna M A5 12500 72 NowVictory,PinkRoyal,PrinceLouie 7  
 5Jly79-12Pin 170 :472 1:113 1:421ft 33 1075 653 44 2nd 13 Sanchez R4 14000 89 CristophrClrion,PrincLoui,ClinchPi 7

The following horse's last race was an allowance race:

### Pagoron

Dk. b. or br. g. 3, by Right Cross—Tenserine, by Pappa Fourway  
 Br.—MacIntyre P & Tabor (Cal) 1979 12 6 2 1 \$55,975  
 Tr.—Frankel Robert \$40,000 1978 8 1 1 0 \$6,460  
 Own.—Chlad Dr A J 1175  
 29Jly79-4Dmr 6f :22 :444 1:082ft \*9-5 1095 11 12 2nd 34 Valenzuela P A5 Alw 92 Summer Time Guy, Lama, Pagoron 5  
 18Jly79-7Hol 6f :213 :441 1:091ft \*4-5 1095 1hd 13 113 1nk Valenzuela P A9 Alw 91 Pagoron, First Sip, Pagan Nashua 10

The following horse's last race was a stakes race:

### Share a Lark

Ch. c. 3, by Wild Lark—Market Share, by Four-and-Twenty  
 Br.—Yank A (Cal) 1979 7 1 0 2 \$24,350  
 Tr.—Cofer Riley S \$40,000 1978 3 2 0 0 \$13,200  
 Own.—Red Baron's Barn 116  
 19May79-8GG 1 1/2 @:4731:1111:414fm 6 114 21 31 473 517 Gonzalez R M6 Sutter 76 Rosi'sSvill,Trrsto'sChoic,GrndAllinc 7  
 6May79-3Hol 1 @:4621:1021:343fm 14 114 21 21 32 373 Olivares F5 Alw 89 Ibacache, Infusive, Share a Lark 6

The following horse's last race was a handicap race:

### Bold L. B. \*

Ch. c. 4, by Bold Blader—Fancy, by Swaps  
 Br.—Firman Pamela H (Ky) 1979 9 3 1 0 \$44,556  
 Tr.—Brandt Louis W 1978 4 3 0 0 \$49,780  
 Own.—Dazoc Stable Inc 119  
 4Aug79-8Dmr 6f :212 :433 1:082ft 13 120 413 773 711 614 Lively J4 B Crosby H 82 Syncopate,WhiteRmmer,FleetTwist 7  
 12Jly79-7Aks 5 1/2 :214 :443 1:034gd 8-5 120 22 2nd 12 143 Lively J3 Speed H 91 Bold L. B., Amadevil, Beau Blade 6  
 21Jun79-7Aks 6f :22 :441 1:10 ft \*9-5 122 313 11 14 113 Melancon L2 Alw 87 Bold L. B., Siron, Roman Zipper 7

Absent Minded's last race was an allowance race so we enter:

A (ENTER)

If you can't figure out the class enter "N" for none.  
 The next question is:

ENTER THE STARTS, 1STS, AND 2NDS THIS YEAR:  
 (IF NONE PRESS ENTER) ?

This information is found in the block of 6 numbers in the upper right of the past performance. Turf races are included in the first two lines of statistics, so the turf statistics can be ignored. Sometimes an "m" is found in place of a number. This is entered as "0" (zero).

The 6 numbers are circled in figure 1.

These are entered as:

1,0,0 (ENTER)

Last years numbers are asked for next:

FOR LAST YEAR ?

These are entered as:

7,1,2 (ENTER)

During the data entry of the first horse the following question appears next:

WHAT KIND OF RACE IS THIS: CLAIMING, ALLOWANCE,  
STAKES, HANDICAP, OR NONE (C,A,S,H,N) ?

This information is found at the top of the column of the race, (see page 4).

Therefore, we enter:

A (ENTER)

Under certain conditions, the following question will occur next:

ENTER THE 4 POINTS OF CALL FOR NEXT TO  
LAST RACE: (IF NONE PRESS ENTER) ?

Therefore, we enter:

8,8,9,9 (ENTER)

After the last entry is completed the corrections prompt appears: (See figure 2 on the following page)

It is followed by the question:

ARE THESE ENTRIES CORRECT (ENTER Y,N,  
OR C TO CHANGE THE NUMBER OF HORSES IN  
THE RACE) ?

If you are satisfied that you entered the data correctly type:

Y (ENTER)

If you made a mistake:

N (ENTER)

You now get to enter the data for the horse again.

If you discover that you have entered the number of horses in the race incorrectly type:

C (ENTER)

## HORSE NUMBER 1 AB:

DISTANCE OF THE LAST RACE IN FURLONGS:	7
4 POINTS OF CALL IN THE LAST RACE:	9 9 9 9
NUMBER OF LENGTHS:	12
POST POSITION IN LAST RACE:	7
CLASS IN LAST RACE:	A
STARTS, 1STS, AND 2NDS THIS YEAR:	1 0 0
FOR LAST YEAR:	7 1 2
4 POINTS OF CALL FOR NEXT TO LAST RACE:	8 8 9 9
THE NUMBER OF HORSES IN THIS RACE:	5
CLASS OF THIS RACE:	A

Figure 2

This results in the prompt:

ENTER THE NUMBER OF HORSES IN THIS RACE?

Your entry will be followed by the corrections prompt.  
(see figure 2).

After you have entered "Y" the program moves on to the next horse. (Note: Star Prince II was disqualified in his last race. Use the April 8th race).

After the last entry for the last horse has been made the following will appear in the middle of the screen:

### THINKING

After up to about 30 seconds the final display will appear.  
For our example this is:\*

<u>POST POS./NAME</u>	<u>PROBABILITY</u>	<u>CORRECT ODDS</u>
2 STAR	.27	2.6 TO 1
3 BOLD	.24	3.2 TO 1
4 NO NO	.23	3.4 TO 1
5 COOL	.08	11.0 TO 1
1 AB	.06	16.3 TO 1

The prompt for line printer output will then appear below the above output.

That's all there is to it. You now have the probable order of finish, win probabilities, and correct odds for each horse. The next chapter describes what to do with this information.

Incidentally, the results for the example race are shown on the following page.

\*NOTE: Because of round-off differences between different brands of computers, you may get slightly different results by ± .01.

# ENTERING PAST PERFORMANCE DATA

Last Raced	Horse	Eqt.	A.Wt	PP	St	1/4	1/2	Str	Fin	Jockey	Odds \$1	
15Apr79 #Hol6	Star Prince II		5	122	2	3	1hd	12	15	15	Pincay L Jr	.60
4Aug79 #Dmr6	Bold L. B.	b	4	119	3	4	31	31 1/2	22	1st	Delahoussaye E	9.00
4Aug79 #Dmr6	No No	b	4	117	4	1	430	425	420	36	McHargue D G	2.40
12Aug79 7Dmr6	Cool Frenchy		4	122	5	2	22	23	31	43	Ortega L E	6.20
2Jun79 10Crc9	Absent Minded	b	7	114	1	5	5	5	5	5	Castaneda M	28.00

OFF AT 3:03 PDT. Start good. Won easily. Time, :21 1/5, :43 3/5, :55 3/5, 1:08 1/5. ~~Track~~ fast.

## \$2 Mutuel Prices:

2-STAR PRINCE II	3.20	2.60	2.10
3-BOLD L. B.	4.20	2.10	
4-NO NO		2.10	

\$5 EXACTA 2-3 PAID \$38.50

Ch. g, by Realm—Welsh Star, by Welsh Abbot. Trainer French Neil. Bred by Mount Coote Stud (Ire).

STAR PRINCE II broke alertly, lugged out while moving to the lead on the backstretch but was much the best and won in hand. BOLD L. B. in contention from the outset, responded near the rail through the stretch but pulled up lame after the race. NO NO rallied gamely outside BOLD L. B. through the stretch. COOL FRENCHY finished after a half. ABSENT MINDED sulked through the first furlong, then gradually made up ground on his field.

Owners— 1, Malibu Vly Fms & Smok Stb; 2, Dazoc Stable Inc.; 3, Bacharach B; 4, Lichlyter Dr or Mrs F E; 5, Heardsdale.

Not bad, huh? Oh well, it always works out that way in gambling system manuals—and this was an Exacta race!! But don't be too excited, we will find out in the next chapter why we didn't have a bet down on Star Prince II.



## CHAPTER 2: OVERLAY BETTING AND MONEY MANAGEMENT

The term "overlay" refers to the situation in which the odds on a horse at post time are higher than they ought to be due to the betting whims of the crowd. What is meant by "ought to be" ? PHD-1 is a tool which is used to provide the user with the win probability for each horse. Win probability can be thought of as the number of chances a horse has of winning out of 100. For example, if a horse's win probability is .50 then he has 50 chances out of 100 of winning. PHD-1 derives the win probability from a large statistical base. A win probability value is based solely on similarities. This means that if PHD-1 assigns a win probability of .5 to a horse, that horse should win 50% of the races in which he runs against similar horses at that distance. Therefore, if a .5 horse runs in 100 such races he will lose 50 races and win 50 races. If the odds on the horse were 1-1 for each of the 100 races you would lose 50 bets and win 50 bets, thus breaking even. Therefore, 1-1 is what the odds "ought to be" (for a .5 horse); i.e. the correct odds or "odds line". Now lets suppose that the actual odds on the horse in 50 of the 100 races were 1-2, and in 50 races were 2-1. If you didn't bet when the odds were 1-2 and only bet when they were 2-1, you would win 25 bets at 2-1 and lose 25 bets. By confining yourself to the overlayed bets you would win twice what you lost. Your advantage would be:

$$\begin{aligned} 25 \text{ bets won} \times (2-1) - 25 \text{ bets lost} / 50 \text{ total bets} \\ = 25/50 = 50\% \end{aligned}$$

This means you won \$0.50 for every dollar wagered.

Therefore, as you can see, if you confine you betting to overlays you should maintain an advantage. In the example in the appendix the final advantage calculated using 174 picks, (of which 82 were predicted as overlays by PHD-1, 17 of which were winners) was 50%.

The correct odds are easily calculated based upon the win probability. The correct odds,  $O$ , are simply:

$$O = (1/p) - 1$$

Where  $p$  is the win probability.

PHD-1 calculates these and displays them in the " correct odds" column.

OVERLAY BETTING AND MONEY MANAGEMENT

The actual odds on the tote board are displayed in the form which is traditional for race tracks, i.e. 1-2 means .5-1 or a pay off of \$3.00 for a \$2.00 bet.

This is an unnecessary hold-out from pre-computer days, but we must live with it. Table 1 shows tote board odds equated to decimal odds. After you use this table a while you will remember that 3-2 is 1.5-1, and 9-5 is 1.8-1 etc. It is suggested that when you write down the odds lines to take to the track that you use tote board notation so you can quickly spot the overlays. An overlay exists when the tote board odds are higher than the correct odds calculated by PHD-1.

In the studies done with PHD-1, only the first two horses picked by PHD-1 in the probable order of finish were considered. Therefore, the user only needs to record the correct odds for the first and second picks and then observe only the odds for those two horses on the tote board.

In the example in chapter 2, Star Prince II and Bold L.B. were the first two picks. Star Prince II went off at 1-2 and Bold L.B. went off at 9-1. Bold L.B. was an overlay, Star Prince II was not. Therefore, we would have wagered on Bold L.B. and not on Star Prince II because of his short odds. We lost even though the computer picked the exact order of finish! Oh well, such things happen.

Theoretically, if you bet on all of the overlayed horses in the race you should realize an advantage over many races. We haven't done a study based on that concept and would welcome a report from a user who has tried it. Our study was done using only the first and second picks.

The odds on the tote board tend to fluctuate right up to post time; sometimes changing after the horses have left the gate. It's up to the discretion and experience of the user at his own track to determine when he has a good grasp on the pay-off odds. At Del Mar and Santa Anita we have found the overlay odds are stable enough for PHD-1 during the last 2-3 minutes before post which is ample time to get a bet down. The long shots reveal themselves quite early.

Our study showed that horses above 15-1 picked by PHD-1 rarely win, at least not often enough to justify betting on them. We recommend confining your betting to overlays below 15-1.

You will probably notice that the win probabilities do not always add up to 1. This is because it was found that PHD-1 tends to over-estimate the win probability above a value of about .2. Therefore we adjusted the higher probability values down slightly to make the system a little more conservative

<u>TOTE BOARD ODDS</u>	<u>DECIMAL ODDS</u>	<u>TOTE BOARD ODDS</u>	<u>DECIMAL ODDS</u>
1-5	.2-1	3-2	1.5-1
2-5	.4-1	8-5	1.6-1
1-2	.5-1	9-5	1.8-1
3-5	.6-1	2-1	2-1
4-5	.8-1	5-2	2.5-1
1-1	1-1	3-1	3-1
6-5	1.2-1	7-2	3.5-1
7-5	1.4-1	9-2	4.5-1

TABLE 1. TOTE BOARD VS. DECIMAL ODDS

MONEY MANAGEMENT

Any parimutual betting system will result in "streaks" for the user. Statistical probabilities, advantage/dis-advantage percentages, curve fits, etc. are all extrapolations to some non existent "large number" of data. The guy going to the track day after day must deal with a small amount of data. Under those conditions streaks are inevitable. It is essential to manage money in some manner to protect against losing streaks and take advantage of winning streaks.

Two methods are displayed in the system work-out in the appendix; the "flat bet" and the "progressive bet".

The flat bet column is displayed based on a \$1.00 bet. Thus, you can multiply the flat bet columns by any amount to see the resultant bet and bankroll as the work-out moves along. The progressive bet is based on betting 10% of the bankroll each time. The initial bankroll is \$1,000.00.

As you can see, flat betting results in a better dollar profit most of the time. However, progressive betting results in higher peak dollar profits during good streaks. On the other hand, flat betting results in disastrous losses during losing streaks while progressive betting slows down the dollars lost during losing streaks.

The method you choose is up to you. If you are a gambler at heart and have sufficient will power to set a limit and stick to it, progressive betting is for you. If you lean toward investing, flat betting will be more to your liking.

In the work-out if the user was betting 10% of his bankroll each time and if he had set a stopping point of \$10,000, he would have pocketed over ten grand on October 14th. The flat bettor would also have been well ahead. The progressive bettor would have lost his profits back in the streak which followed if he didn't pocket his profits, with the flat bettor finishing ahead of him in profits.

Quirin<sup>3</sup> suggests that 6% of the bankroll be wagered for systems able to pick greater than 30% winners, with better than a 25% return, in order to minimize the chances of tapping out.

Fabricand<sup>4</sup> shows how an actual probability of tapping out can be calculated based on flat betting. He calls this the "probability of ruin".

The amount you pick for flat or progressive betting should be based on dry runs done with your own data base. Use what you feel comfortable with.

As you may suspect, the greater the chance a horse has of winning, the greater is the percentage of the bankroll which may be risked. This is the basis of the "Kelly Money Management System" which Steve Brecher<sup>5</sup>, Dr. Thorp<sup>6</sup>, and Mike Warren<sup>7</sup> in his probability based selection system have written about.

The Kelly Criteria says that the percentage of the bankroll which may be risked is:

$$\% \text{ of bankroll} = (0p - (1-p))/0 \times 100$$

Where 0 is the tote board odds and p is the win probability.

This method does not appear to work well with the appendix study. I suspect that this is because of the relatively small number of overlays wagered on due to confining the picks to the first two horses. I suspect it may work well by dividing the money wagered between all of the overlaid horses in a race. Dr. Thorp describes how to do this in his Gambling Times article<sup>6</sup>. The procedure goes somewhat beyond the scope of this manual.

Above all, regardless of which money management technique you use, never use a bankroll larger than what you can afford to lose. You can tap-out with any system, even with PHD-1. However, we've done the best we can to see to it that your chances of winning are greater than your chances of losing. You can't ask for more than that.

---

<sup>3</sup>Quirin, William L., PHD, Winning At The Races, Joe Computer  
22713 Ventura Blvd. Ste. F Woodland Hills, CA 91364 (\$21.95 +.75 P&H)

<sup>4</sup>Fabricand, Burton P., Horse Sense

<sup>5</sup>Brecher, Steve L., Beating The Races With A Computer, Joe Computer  
22713 Ventura Blvd. Ste. F Woodland Hills, CA 91364 (\$14.95 +.75 P&H)

<sup>6</sup>Thorp, Edward O., The Kelly Money Management System, Gambling  
Times Magazine, vol.3 number 9, pp. 91-92, December, 1979

<sup>7</sup>Warren, Mike, The Method (How to Rob Racetracks Legally),  
The Baltimore Bullentin, Inc. Professional Building, 23-25  
Walker Ave. Baltimore, Maryland 21208 (\$10.00)

### CHAPTER 3:  ARCHIVE

ARCHIVE is a subroutine within the PHD-1 program. Its purpose is to allow the advanced user to store the results of PHD-1's calculations on cassette. The use of ARCHIVE is optional and is intended for users who desire to do studies such as the one in the appendix. The subroutine uses data write statements to output the race identification code, number of horses, post position number, name, and win probability for each horse to data tape. This is done using variable length records for efficient use of the tape.

The calls necessary to use ARCHIVE are commented out of the program. To activate ARCHIVE refer to the addenda for your computer.

PHD-1 does not support the reading of data tapes. If you want to read the tapes you will have to edit ARCHIVE and build your own routine around it.

JOE COMPUTER is interested in how well PHD-1 does. If you use ARCHIVE to produce a study such as the one in the appendix, we are interested in purchasing it. The study should be of at least 100 sprint races, preferably consecutive races. If you complete such a study please write with details so we can make an offer.

# APPENDIX

The tab-run beginning on the next page represents a "work-out" of PHD-1. 87 races are represented from the 4th race on August 25, 1979 at Del Mar to the 7th race on October 21, 1979 at the Santa Anita Oaktree meet. All of the sprint races occurring during that period are considered consecutively. Maiden race are not considered unless they have sufficient past performance data for each horse. The first two PHD-1 picks only are considered for each race. Bets are placed only on overlays.

The column definitions are as follows:

- DATE: This is the date-race number code. 82504 means the 4th race on August 25.
- PP: This is the post position number of the horse being considered.
- ODDS-LINE: This is the odds calculated by PHD-1 for the horse.
- ACT. ODDS: This is the actual tote board odds taken from the results.
- B?: This indicates whether or not the pick is an overlay and results in a bet. A "1" indicates a bet, a "0" no bet.
- W: This is the post position number of the winner.
- W/L: This indicates whether a bet made was won or lost. A win is indicated by a "1", a loss by a "0".
- \$1.00 Bet: This indicates the amount ahead or behind assuming \$1.00 bets are made.
- AVER. ADV.: This is the running average advantage determined by dividing the \$1.00 bet column by the number of bets made.
- 10% bet: This is the amount wagered using a 10% progressive bet based on a beginning \$1,000.00 bank-roll.
- BNK-ROLL: This is the running bank-roll starting with \$1,000.00.
- # WIN: This is the running total number of bets won.
- # PICKS: This is the running total number of overlays bet on.

GRAPH 1

This is a graph of the running average taken from the workout.

GRAPH 2

This is a graph showing the loci of the predicted probability versus actual win percentage. This was based on a total of 851 horses for the seasons shown in the work-out. This in reality is a bar-graph with each bar representing a closed sample of horses. The win probabilities were grouped from 0-.025, .026-.05, .051-.075 etc. and the number of winners within the category was divided by the total to obtain the win percentage. The largest was the category from .05 to .1 with 224 horses.

For any handicapping system claiming to predict an odds line, this graph is the final judgement. A system stands or falls depending upon how close its characteristic points fall to the ideal line. As you can see, PHD-1's characteristics are quite close.



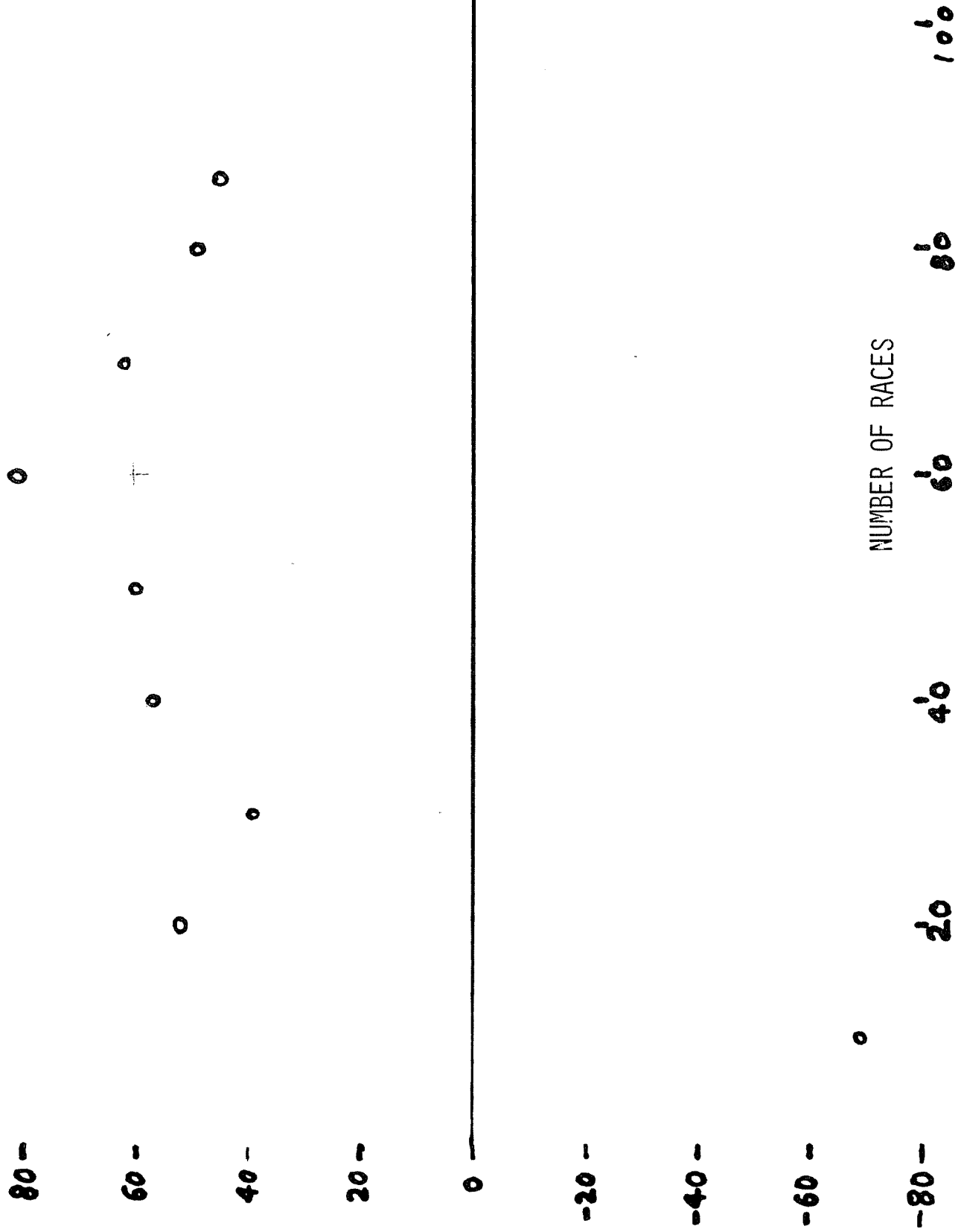
DATE	PP	ODDS LINE	ACT. E? ODDS	W L	W L	\$1.00 BET	AVER ADV	10% BET	BNK ROLL	# WIN	# PICKS
82504	5	2.3	5.0	1	2 0	-1.00	0.00	100.	900.0	0	1
82504	4	3.3	3.3	1	2 0	-2.00	0.00	90.	810.0	0	2
82507	2	2.1	0.7	0	4 0	-2.00	0.00	81.	810.0	0	2
82507	4	2.2	2.4	1	4 1	0.40	0.13	73.	985.2	1	3
82602	1	1.8	20.9	0	7 0	0.40	0.13	74.	985.2	1	3
82602	3	2.9	12.9	1	7 0	-0.60	-0.15	91.	894.2	1	4
82604	1	2.3	2.5	1	2 0	-1.60	-0.32	89.	805.2	1	5
82604	2	3.0	2.5	0	2 0	-1.60	-0.32	81.	805.2	1	5
82607	3	3.0	10.1	1	6 0	-2.60	-0.43	81.	724.2	1	6
82607	5	3.7	3.4	0	6 0	-2.60	-0.43	72.	724.2	1	6
82701	4	2.7	3.3	1	6 0	-3.60	-0.51	72.	652.2	1	7
82701	2	4.6	6.9	1	6 0	-4.60	-0.58	65.	587.2	1	8
82703	8	3.5	31.1	0	7 0	-4.60	-0.58	59.	587.2	1	8
82703	2	4.6	3.4	0	7 0	-4.60	-0.58	53.	587.2	1	8
82901	8	1.7	3.0	1	1 0	-5.60	-0.62	59.	528.2	1	9
82901	1	4.0	2.0	0	1 0	-5.60	-0.62	53.	528.2	1	9
82904	3	2.7	0.6	0	3 0	-5.60	-0.62	48.	528.2	1	9
82904	4	3.7	6.6	1	3 0	-6.60	-0.66	48.	480.2	1	10
82905	5	3.0	3.5	1	1 0	-7.60	-0.69	48.	432.2	1	11
82905	1	4.3	3.2	0	1 0	-7.60	-0.69	43.	432.2	1	11
82907	1	4.6	7.4	1	4 0	-8.60	-0.72	43.	389.2	1	12
82907	4	5.3	8.8	1	4 1	0.20	0.02	39.	732.4	2	13
82909	1	4.1	16.8	0	3 0	0.20	0.02	35.	732.4	2	13
82909	2	4.3	12.4	1	3 0	-0.80	-0.06	70.	662.4	2	14
83005	11	4.2	36.8	0	2 0	-0.80	-0.06	66.	662.4	2	14
83005	5	5.1	29.0	0	2 0	-0.80	-0.06	60.	662.4	2	14
83008	2	1.6	2.5	1	3 0	-1.80	-0.12	66.	596.4	2	15
83008	3	5.1	12.8	1	3 1	11.00	0.69	60.	1364.4	3	16
83009	11	3.7	6.2	1	3 0	10.00	0.59	136.	1228.4	3	17
83009	1	7.2	8.7	1	3 0	9.00	0.50	123.	1105.4	3	18
83101	6	3.8	1.3	0	6 0	9.00	0.50	111.	1105.4	3	18
83101	1	4.1	19.0	0	6 0	9.00	0.50	99.	1105.4	3	18
83105	3	3.2	2.0	0	3 0	9.00	0.50	101.	1105.4	3	18
83105	4	5.2	3.9	0	3 0	9.00	0.50	100.	1105.4	3	18
83107	4	5.2	3.0	0	4 0	9.00	0.50	100.	1105.4	3	18
83107	2	5.9	8.3	1	4 0	8.00	0.42	100.	1005.4	3	19
83108	8	3.7	17.4	0	3 0	8.00	0.42	101.	1005.4	3	19
83108	1	4.2	12.8	1	3 0	7.00	0.35	90.	915.4	3	20
90101	5	2.0	4.2	1	1 0	6.00	0.29	92.	823.4	3	21
90101	1	5.7	5.5	1	1 1	11.50	0.52	82.	1274.4	4	22
90107	6	3.0	1.7	0	6 0	11.50	0.52	74.	1274.4	4	22
90107	5	4.9	17.2	0	6 0	11.50	0.52	120.	1274.4	4	22
90108	2	4.9	24.4	0	9 0	11.50	0.52	115.	1274.4	4	22
90108	6	6.6	24.7	0	9 0	11.50	0.52	116.	1274.4	4	22
90204	5	2.8	15.8	0	3 0	11.50	0.52	116.	1274.4	4	22
90204	6	3.8	3.5	0	3 0	11.50	0.52	116.	1274.4	4	22
90205	6	4.2	3.6	0	6 0	11.50	0.52	116.	1274.4	4	22
90205	8	5.6	15.0	0	6 0	11.50	0.52	116.	1274.4	4	22
90301	2	2.4	1.5	0	3 0	11.50	0.52	116.	1274.4	4	22
90301	7	3.0	16.4	0	3 0	11.50	0.52	116.	1274.4	4	22
90501	2	4.8	7.2	1	11 0	10.50	0.46	127.	1147.4	4	23
90501	8	5.9	2.3	0	11 0	10.50	0.46	115.	1147.4	4	23
90504	3	2.5	3.0	1	3 1	13.50	0.56	115.	1492.4	5	24
90504	2	2.7	2.1	0	3 0	13.50	0.56	103.	1492.4	5	24

90505	3	3.7	2.4	0	1	0	13.50	0.56	139.	1492.4	5	24
90505	4	4.5	1.0	0	1	0	13.50	0.56	135.	1492.4	5	24
90601	3	2.2	3.3	1	5	0	12.50	0.50	149.	1343.4	5	25
90601	4	3.6	3.2	0	5	0	12.50	0.50	134.	1343.4	5	25
90602	3	2.2	3.0	1	11	0	11.50	0.44	134.	1209.4	5	26
90602	7	3.0	7.5	1	11	0	10.50	0.39	121.	1088.4	5	27
90606	4	2.0	3.0	1	1	0	9.50	0.34	109.	979.4	5	28
90606	6	4.1	2.5	0	1	0	9.50	0.34	98.	979.4	5	28
90608	2	3.5	32.9	0	1	0	9.50	0.34	88.	979.4	5	28
90608	8	3.8	4.5	1	1	0	8.50	0.29	89.	890.4	5	29
90609	5	5.6	5.9	1	7	0	7.50	0.25	89.	801.4	5	30
90609	7	6.4	1.7	0	7	0	7.50	0.25	80.	801.4	5	30
90705	10	2.5	27.6	0	8	0	7.50	0.25	72.	801.4	5	30
90705	2	4.1	0.7	0	8	0	7.50	0.25	73.	801.4	5	30
90801	3	3.8	9.7	1	3	1	17.20	0.55	80.	1577.4	6	31
90801	2	4.9	1.4	0	3	0	17.20	0.55	72.	1577.4	6	31
90804	2	4.0	1.4	0	2	0	17.20	0.55	151.	1577.4	6	31
90804	4	4.6	1.9	0	2	0	17.20	0.55	143.	1577.4	6	31
90805	4	2.3	1.9	0	1	0	17.20	0.55	143.	1577.4	6	31
90805	1	3.5	2.5	0	1	0	17.20	0.55	143.	1577.4	6	31
90807	3	2.3	1.1	0	2	0	17.20	0.55	143.	1577.4	6	31
90807	2	5.8	5.6	1	2	1	22.80	0.71	143.	2378.2	7	32
90901	2	2.6	7.2	1	10	0	21.80	0.66	238.	2140.2	7	33
90901	1	6.1	55.0	0	10	0	21.80	0.66	214.	2140.2	7	33
90905	2	3.9	7.0	1	6	0	20.80	0.61	214.	1926.2	7	34
90905	5	4.0	9.0	1	6	0	19.80	0.57	193.	1733.2	7	35
90907	2	2.4	1.0	0	2	0	19.80	0.57	173.	1733.2	7	35
90907	7	2.4	2.1	0	2	0	19.80	0.57	156.	1733.2	7	35
91002	6	3.1	9.5	1	3	0	18.80	0.52	173.	1560.2	7	36
91002	2	4.1	4.0	0	3	0	18.80	0.52	156.	1560.2	7	36
91007	7	2.4	3.2	1	5	0	17.80	0.48	156.	1404.2	7	37
91007	3	3.6	2.9	0	5	0	17.80	0.48	140.	1404.2	7	37
91009	8	2.4	4.5	1	1	0	16.80	0.44	140.	1264.2	7	38
91009	2	4.5	3.7	0	1	0	16.80	0.44	126.	1264.2	7	38
91202	4	2.2	3.6	1	4	1	20.40	0.52	126.	1138.2	8	39
91202	7	2.4	3.6	1	4	0	19.40	0.49	114.	1603.8	8	40
100501	10	6.1	3.5	0	4	0	19.40	0.49	102.	1603.8	8	40
100501	4	6.9	13.0	1	4	1	32.40	0.79	150.	3553.8	9	41
100505	1	6.4	12.4	1	7	0	31.40	0.75	355.	3198.8	9	42
100505	7	6.4	2.8	0	7	0	31.40	0.75	320.	3198.8	9	42
100508	3	3.9	1.8	0	4	0	31.40	0.75	288.	3198.8	9	42
100508	5	4.9	8.7	1	4	0	30.40	0.71	291.	2907.8	9	43
100701	4	3.1	16.7	0	5	0	30.40	0.71	291.	2907.8	9	43
100701	7	4.8	5.8	1	5	0	29.40	0.67	262.	2645.8	9	44
100102	5	5.2	6.7	1	9	0	28.40	0.63	265.	2380.8	9	45
100102	6	5.2	9.8	1	9	0	27.40	0.60	238.	2142.8	9	46
100703	2	2.9	3.9	1	3	0	26.40	0.56	214.	1928.8	9	47
100703	1	3.3	2.5	0	3	0	26.40	0.56	193.	1928.8	9	47
100705	4	3.2	1.2	0	6	0	26.40	0.56	174.	1928.8	9	47
100705	3	4.7	49.8	0	6	0	26.40	0.56	176.	1928.8	9	47
101001	9	3.6	4.9	1	6	0	25.40	0.53	193.	1735.8	9	48
101001	1	4.8	5.3	1	6	0	24.40	0.50	174.	1561.8	9	49
101002	1	5.8	11.5	1	11	0	23.40	0.47	156.	1405.8	9	50
101002	4	5.8	29.3	0	11	0	23.40	0.47	141.	1405.8	9	50
101005	3	4.0	6.5	1	7	0	22.40	0.44	141.	1264.8	9	51
101005	7	5.7	11.4	1	7	1	33.80	0.65	126.	2701.2	10	52
101007	4	4.2	2.7	0	4	0	33.80	0.65	114.	2701.2	10	52
101007	3	4.6	3.2	0	4	0	33.80	0.65	259.	2701.2	10	52
101008	4	3.9	17.8	0	3	0	33.80	0.65	244.	2701.2	10	52
101008	1	4.5	1.3	0	3	0	33.80	0.65	246.	2701.2	10	52

101101	2	4.5	25.9	0	1	0	33.80	0.65	246.	2701.2	10	52
101101	11	4.5	3.0	0	1	0	33.80	0.65	246.	2701.2	10	52
101104	5	1.1	2.1	1	5	1	35.90	0.68	270.	3268.2	11	53
101104	3	10.5	5.1	0	5	0	35.90	0.68	243.	3268.2	11	53
101105	5	6.7	3.5	0	8	0	35.90	0.68	303.	3268.2	11	53
101105	8	6.7	7.8	1	8	1	43.70	0.81	297.	5584.8	12	54
101109	5	5.8	12.8	1	8	0	42.70	0.78	558.	5026.8	12	55
101109	8	5.8	7.2	1	8	1	49.90	0.89	503.	8648.4	13	56
101401	2	1.3	2.5	1	2	1	52.40	0.92	865.	7783.4	14	57
101401	8	5.0	6.2	1	2	0	51.40	0.89	778.	10032.9	14	58
101402	2	2.7	5.6	1	3	0	50.40	0.85	1003.	9029.9	14	59
101402	5	3.3	1.7	0	3	0	50.40	0.85	903.	9029.9	14	59
101403	2	1.4	4.8	1	6	0	49.40	0.82	903.	8126.9	14	60
101403	3	2.7	7.7	1	6	0	48.40	0.79	813.	7313.9	14	61
101405	1	2.5	4.1	1	7	0	47.40	0.76	731.	6582.9	14	62
101405	2	5.2	10.2	1	7	0	46.40	0.74	658.	5924.9	14	63
101702	5	2.3	3.3	1	7	0	45.40	0.71	592.	5332.9	14	64
101702	3	3.5	27.7	0	7	0	45.40	0.71	533.	5332.9	14	64
101704	3	2.3	11.6	1	6	0	44.40	0.68	533.	4799.9	14	65
101704	6	2.5	1.6	0	6	0	44.40	0.68	480.	4799.9	14	65
101707	2	3.1	9.0	1	3	0	43.40	0.66	480.	4319.9	14	66
101707	3	3.9	0.6	0	3	0	43.40	0.66	432.	4319.9	14	66
101708	2	2.6	0.5	0	2	0	43.40	0.66	389.	4319.9	14	66
101708	3	2.9	3.6	1	2	0	42.40	0.63	393.	3926.9	14	67
101709	2	1.6	3.3	1	2	1	45.70	0.67	393.	5223.8	15	68
101709	1	2.8	2.0	0	2	0	45.70	0.67	353.	5223.8	15	68
101801	4	1.5	11.3	1	5	0	44.70	0.65	522.	4701.8	15	69
101801	6	4.6	50.1	0	5	0	44.70	0.65	470.	4701.8	15	69
100802	4	3.1	19.0	0	9	0	44.70	0.65	423.	4701.8	15	69
100802	6	6.4	52.9	0	9	0	44.70	0.65	428.	4701.8	15	69
101805	4	3.2	3.5	1	4	1	48.20	0.69	470.	4231.8	16	70
101805	5	5.0	11.2	1	4	0	47.20	0.66	423.	5923.8	16	71
101807	5	2.5	4.3	1	2	0	46.20	0.64	592.	5331.8	16	72
101807	4	3.4	1.8	0	2	0	46.20	0.64	533.	5331.8	16	72
101809	9	3.0	3.1	1	2	0	45.20	0.62	533.	4798.8	16	73
101809	7	5.2	1.8	0	2	0	45.20	0.62	480.	4798.8	16	73
101901	3	3.5	26.0	0	1	0	45.20	0.62	432.	4798.8	16	73
101901	4	3.9	20.0	0	1	0	45.20	0.62	437.	4798.8	16	73
101902	1	4.2	3.4	0	4	0	45.20	0.62	436.	4798.8	16	73
101902	3	4.5	6.5	1	4	0	44.20	0.60	436.	4362.8	16	74
101904	2	1.3	5.2	1	7	0	43.20	0.58	436.	3926.8	16	75
101904	3	4.9	26.3	0	7	0	43.20	0.58	393.	3926.8	16	75
101905	7	4.2	4.1	0	1	0	43.20	0.58	353.	3926.8	16	75
101905	6	4.6	6.6	1	1	0	42.20	0.56	357.	3569.8	16	76
102001	6	2.1	2.6	1	4	0	41.20	0.54	357.	3212.8	16	77
102001	8	4.9	3.4	0	4	0	41.20	0.54	321.	3212.8	16	77
102002	4	0.9	4.8	1	5	0	40.20	0.52	321.	2891.8	16	78
102002	1	3.5	2.6	0	5	0	40.20	0.52	289.	2891.8	16	78
102004	4	1.8	0.6	0	1	0	40.20	0.52	260.	2891.8	16	78
102004	5	3.3	3.0	0	1	0	40.20	0.52	263.	2891.8	16	78
102005	2	2.1	2.8	1	5	0	39.20	0.50	289.	2602.8	16	79
102005	5	2.1	1.2	0	5	0	39.20	0.50	260.	2602.8	16	79
102108	1	2.4	4.2	1	2	0	38.20	0.48	260.	2342.8	16	80
102108	2	2.9	3.5	1	2	1	41.70	0.51	234.	3161.8	17	81
102102	4	3.5	4.6	1	3	0	40.70	0.50	316.	2845.8	17	82
102102	5	5.3	4.5	0	3	0	40.70	0.50	285.	2845.8	17	82
102106	2	4.0	1.2	0	1	0	40.70	0.50	256.	2845.8	17	82
102106	5	4.2	3.4	0	1	0	40.70	0.50	259.	2845.8	17	82
102107	1	2.2	1.7	0	2	0	40.70	0.50	259.	2845.8	17	82
102107	7	5.7	4.2	0	2	0	40.70	0.50	259.	2845.8	17	82

% ADVANTAGE

GRAPH 1 - AVERAGE ADVANTAGE



GRAPH 2 - SYSTEM CURVE

