MAT 1041

Professional Skills Development

Project #2

Horserace betting

The group is given the summarised results of 300 horse races. The starting prices (odds) for the first five horses are shown, as well as the starting price of the favourite if it did not finish in the top five places. The position in which the favourite finished and the number of runners is also given. The data can be found on SurreyLearn; you will need the workbook entitled `Horse Races'. Each race meeting consists of six races, so races 1 to 6 are in meeting 1, 7 to 12 in meeting 2 and so forth.

The objectives of the project are to

1. acquire a basic knowledge of the mathematics of horserace betting
2. gain a understanding of the horse racing industry
3. simulate different betting strategies with the goal of maximising your winnings.

No prior knowledge of horse racing is required.

Odds, starting prices and types of bet

Starting prices are expressed as a ratio in the database in the following manner. If the odds are quoted as n to m this is expressed as a decimal number $\frac{n}{m}$, in other words in effect an assumed probability (plus the bookmaker's margin) of $p = \frac{n}{n+m}$ of the horse winning.

- The money placed on a bet is known as the **stake** and is returned if the bet is successful.
- Suppose the odds are n to 1 and the punter places a bet of B **to win**. If the horse wins she receives $B\ (n+1)$, i.e. the winnings plus the return of the amount staked. If the horse does not win she loses her stake.
- It is also possible to bet on a horse **to place.** If you bet on a horse to finish in a place, you are backing the horse to finish in the top 2, 3 or 4, depending on the number of runners in the race. You cannot bet on a horse to place in races with 4 or fewer runners. The winnings on a bet to place are one quarter of those for a bet to win. Thus if a bet of ***B*** to place is successful then the punter receives $B\left(\frac{n}{4}+1\right)$,
- It is possible to place a bet on a horse **either** to win **or** to place in the same race. Thus if a horse is quoted with odds of 4/1, an **eachway** bet of £10 will consist of a £5 bet to win and a £5 bet to place. If the horse wins the punter receives £25 (£20 winnings and the £5 bet) from the bet to win and £10 (£5 winnings and the £5 bet) from the bet to place, a total of £25 in winnings and the return of the £10 stake. If the horse is only placed the punter receives £10 (£5 winnings and the £5 bet) from the bet to place.

There are **many other types of bet** which are possible. Start by looking at this website:

https://support.paddypower.com/app/answers/detail/a_id/128/p/6/related/1/session/L2F2LzEvdGltZS8xNDcyNTY0MjQzL3NpZC9jdk81ZG5abQ%3D%3D

Group report

The report should have the following chapters:

- Introduction (written by the group members collectively)
- Chapters on the following topics: (one written individually by each group member)[1]
    a) History of bookmaking, on- and off- course betting
    b) Types of bets and potential payoffs
    c) Theory of bookmaking and the way in which odds are calculated
    d) Why do people gamble?
    e) Applications of mathematics to horse race betting
    f) Would horse racing exist today were it not for gambling?
    g) Explain and discuss the "gambler's fallacy"

- These topic chapters are written and submitted individually as reports, as one unit of individual assessment. They are then integrated by the group into a coherent report with a consistent overall style, with appropriate cross referencing, as part of one unit of group assessment.

- The major findings of the MATLAB and Excel analysis (written by the group members collectively).

The report is submitted within the group Wiki.

Excel analysis

- **Part 1**

Perform the following basic analyses ***using the data provided*** in "Horse Races" and summarise your findings and comments in your group report and your group presentation. As appropriate you should use graphs, charts and descriptive statistics.

    - the relationship if any between the frequency with which favourites win races and

[1] If there are fewer than seven members in the group pick as many topics as there are group members

- the number of runners
- the starting prices of the favourite.

- the distributions of starting prices within a race and over the whole data set
- consider the relationships if any between starting prices and finishing positions for all five first finishing horses
- the relationship between the odds for the favourite and the number of runners for any given race
- find the distribution of the places in which favourites finished in all 300 races
- considering the 50 race meetings
  - compute descriptive and comparative statistics for these meetings
  - examine the frequency with which favourites won at these meetings

80 marks

- **Part 2**

The group is free to expand the topics covered in their statistical analysis to other related and relevant aspects and to use any additional statistical information they wish.

A possible topic is the statistical analysis of Grand National results, start by looking at http://www.fatjockey.com/festivals/racing_festivals.php?Grand-National-Stats-8

20 marks

The Excel spreadsheets used for data manipulation and analysis, should be edited and annotated to be comprehensible to the reader with commands and formulae clearly shown, and attached to the group Wiki contained within one single workbook.

Modelling betting on horse races using MATLAB

You are required to amend the spreadsheet so that the data can be loaded into MATLAB effectively but you must not remove anything other than column titles and headings. Your amended spreadsheet and your MATLAB code must be submitted as part of your group Wiki along with a document displaying any output that your code produces for solutions.

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Betting strategies

You have £5,000 capital to take to these races and you decide to place £100 each time you make a bet. There is no cost associated with placing a bet. If you lose all your capital you are considered to have lost everything – borrowing is not allowed. You should consider the data set to represent the as yet unknown results of 300 horse races. The objective is to maximise your winnings.

- Use MATLAB to answer all of the following questions, present and comment on your results in your group report and your presentation using appropriate graphics.
    a. You bet on the favourite **to win** each time, starting with the first race. [If your horse wins you win your bet multiplied by the odds and get your stake back. If your horse does not come in first place you lose your stake]. Calculate the value of your capital after these 300 races.
    b. What happens if you start with only £1,000 in the bank? Amend your code to bet other amounts than a at £100. What is the smallest size of bet (to the nearest pound) that would result in your losing all your capital before the end of the 300 races?
    c. Now suppose that you bet on your horse to **place**; for this step assume that this means that you are betting that your horse will come either first, second or third. If your horse places, you win 25% of the odds multiplied by your bet and your stake back and if not you lose your stake. Calculate the value of your capital after these 300 races given that you bet on the favourite to place.
    d. Now consider **eachway** betting, with the same assumption about place betting as in (b) above. Calculate the value of your capital after these 300 races given that you bet eachway on the favourite.
    e. Amend your code to calculate the value of your capital after these 300 races if you were to place the bet as 1% of the size of your capital at the time of the race as opposed to a at bet of £100. Do this for each type of bet.
    f. Amend your code to take into account the placing requirements based on the number of runners. For races with 16 or more runners, backing a horse to place is betting that it will finish in the first 4 places. For races with 8 through 15 runners, the top 3. If there are only 5, 6 or 7 runners, you can back your selection to finish in the top 2. What was the best strategy for this set of races?

60 marks

Further investigation

There are further marks available for work on extending the modelling as the group decides. The investigation could for example cover some of the following, but need not be limited to these possible topics:

a. betting on each favourite as above only if the starting price is above (or perhaps below) a given threshold price.

b. **double, treble** or **accumulator** betting on the favourite over all of the races in the given race meeting.
c. varying the size of the stake with the odds available (the higher the odds the higher or lower the stake).

40 marks