

BIKEMASTER User's Manual
By Don Axtell, 9 October, 1987

To run BIKEMASTER type the following :

RUN SDISK:[SAG.DVA.PROGRAM]BIKEMASTER.EXE

BIKEMASTER displays a list of 19 variables as shown below. Together they help to calibrate and quantify any bicycle ride so that predictions can be made on future rides. Knowing how each of these variables interact with the others, the user will become a master of his bike. To use this program, simply choose a variable and enter a new value. BIKEMASTER then automatically makes all adjustments to the other variables and updates the display. Both old and new values are shown side-by-side for ease of comparison. Each of these 19 variables is covered in the following pages.

| BIKEMASTER - Learn to be the master of your bicycle | | | | |
|---|---------|---------|---------|---------|
| A-Distance to ride(miles) = | 1.8 | 1.8 | 1.8 | 0.0 |
| B-Road gradient (percent) = | 10.5 | 10.5 | 10.5 | 0.0 |
| C-Elevation change (feet) = | 997.9 | 997.9 | 997.9 | 0.0 |
| D-Weight of bike (pounds) = | 25.0 | 25.0 | 25.0 | 0.0 |
| E-Weight of rider(pounds) = | 180.0 | 180.0 | 180.0 | 0.0 |
| F-Rolling friction = | 0.01000 | 0.01000 | 0.01000 | 0.00000 |
| G-Wind friction factor = | 0.01621 | 0.01621 | 0.01621 | 0.00000 |
| H-Wind speed (mph) = | 0.0 | 0.0 | 0.0 | 0.0 |
| I-Wind angle (0deg=head) = | 0.0 | 0.0 | 0.0 | 0.0 |
| J-Gear ratio = | 43.6 | 43.6 | 43.6 | 0.0 |
| K-Pace or Cadance (rpm) = | 59.9 | 55.5 | 48.0 | 0.0 |
| L-Speed (mph) = | 7.8 | 7.2 | 6.2 | 0.0 |
| M-Time (minutes) = | 13.9 | 15.0 | 17.3 | 0.0 |
| N-Weight load (pounds) = | 21.4 | 21.4 | 21.4 | 0.0 |
| O-Rolling load (pounds) = | 2.0 | 2.0 | 2.0 | 0.0 |
| P-Wind load (pounds) = | 1.0 | 0.8 | 0.6 | 0.0 |
| Q-Total load (pounds) = | 24.4 | 24.3 | 24.1 | 0.0 |
| R-Work (pound_miles) = | 44.0 | 43.7 | 43.3 | 0.0 |
| S-Power(pound_miles/hour) = | 189.8 | 174.9 | 150.0 | 0.0 |
| Enter Item, Value : | | | | |

A - DISTANCE (In miles) :

Distance is how long the ride is or will be. A long trip should be broken down into sections, with each section having a constant Gradient (B). Only one section can be considered at a time. A change in Distance will affect Elevation (C), Time (M), and Work (R).

B - GRADIENT (In percent) :

Gradient is a measure of how much uphill (+) or downhill (-) slope there is on the ride section considered. Gradient is defined as the number of vertical feet change for each 100 feet of horizontal. Gradients greater than 10 are very steep hills. A change of Gradient will affect Elevation (C), Cadance (K), Speed (L), Time (M), Weight load (N), Wind load (P), Total load (Q), and Work (R). If the change in Gradient causes a Speed (L) greater than 35 mph, then Speed is set to 35 and Power (S) is changed.

C - ELEVATION (in feet) :

Elevation is the vertical change from the beginning to the end of the ride section. Positive Elevation is uphill. When Elevation is changed, Gradient (B) is recalculated, and then all other changes are based on the new Gradient.

D - BIKE WEIGHT (In pounds) :

Bike weight is the weight of the bicycle plus any additional equipment. A change in Bike weight affects Cadance (K), Speed (L), Time (M), Rolling load (O), Weight load (N), Total load (Q), and Work (R).

E - RIDER WEIGHT (In pounds) :

Rider weight is combined with Bike weight (D) to get the total weight. A change in Rider weight affects Cadance (K), Speed (L), Time (M), Rolling load (O), Weight load (N), Total load (Q), and Work (R).

F - ROLLING FRICTION (unitless) :

Rolling friction is a factor which is multiplied by the total weight (D+E), which results in Rolling load (O). A change in Rolling friction affects Cadance (K), Speed (L), Time (M), Rolling load (O), Total load (Q), and Work (R). Appropriate values for Rolling friction are :

| TIRE SIZE / ROAD CONDITION | ROLLING FRICTION |
|----------------------------|------------------|
| Thin tire / Smooth road | .010 |
| Thin tire / Rough road | .020 |
| Fat tire / Smooth road | .020 |
| Fat tire / Rough road | .025 |
| Fat tire / Loose dirt | .040 |

G - WIND FACTOR (unitless) :

Wind factor is multiplied by the square of the relative Speed to get Wind load (P). A change in Wind factor affects Cadance (K), Speed (L), Time (M), Wind load (N), Total load (Q), and Work (R). Because the wind equation uses the square of Speed, the Choice of Wind factor becomes more important at higher Speeds. Wind factor changes according to riding position as shown below :

| RIDING POSITION | WIND FACTOR |
|--------------------------------------|-------------|
| Crouched low, hands on bottom bars | .00801 |
| Hands on top bars, drafting in group | .00801 |
| Hands on top bars, no drafting | .01621 |
| Sitting upright or standing | .02414 |

012
HANDS ON BOTTOM,
NO DRAFTING

H - WIND SPEED (In miles per hour) :

If there is a constant wind during the ride, its speed should be entered here. The direction of the wind is entered in (I). A change in Wind Speed affects Cadance (K), Speed (L), Time (M), Wind load (P), Total load (Q), and Work (R).

I - WIND DIRECTION (In degrees) :

Wind direction is 0 for a headwind and 180 for a tailwind. Wind Direction, Wind speed (H), Speed (L), and Wind factor (G), all go into the equation to calculate Wind load (P). A change in Wind Direction affects Cadance (K), Speed (L), Time (M), Wind load (P), Total load (Q), and Work (R). A headwind means more Wind load and a slower Speed.

J - GEAR (In inches) :

Gear is calculated by taking the number of teeth in the front sprocket divided by the number of teeth in the back sprocket and multiplying by the wheel diameter. Gear multiplied by 3.14 would equal the number of inches of forward movement for each rotation of the pedals. The tables on the next page list Gears for all tooth combinations for both 26" and 27" wheels. A change in Gear affects Cadance (K) only, as Speed (L) is kept constant.

K - CADANCE (In revolutions per minute) :

Cadance is a measure of how fast the pedals are rotating. A change in Cadance affects Speed (L), Time (M), Wind load (P), Total load (Q), Work (R), and Power (S). Typical Cadance values are :

| TYPE OF PEDAL | RANGE | OPTIMUM |
|-------------------|------------|---------|
| With toe-clips | 50-120 | 90 |
| Without toe-clips | 50-90 | 70 |
| Up steep hills | 40 minimum | 70 |

TECHNICAL DATA FOR YOUR CONVENIENCE

GEAR CHART FOR 26" WHEEL

| TEETH REAR SPROCKET | Number of teeth, Chainwheel (large front sprocket) | | | | | | | | | | | | | | |
|---------------------------|--|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| | 36 | 38 | 40 | 42 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 |
| 14 | 66.9 | 70.6 | 74.3 | 78.0 | 81.7 | 83.6 | 85.4 | 87.3 | 89.1 | 91.0 | 92.9 | 94.7 | 96.6 | 98.4 | 100.3 |
| 15 | 62.4 | 65.9 | 69.3 | 72.8 | 76.3 | 78.0 | 79.7 | 81.5 | 83.2 | 84.9 | 86.7 | 88.4 | 90.1 | 91.9 | 93.6 |
| 16 | 58.5 | 61.8 | 65.0 | 68.3 | 71.5 | 73.1 | 74.8 | 76.4 | 78.0 | 79.6 | 81.3 | 82.8 | 84.5 | 86.1 | 87.5 |
| 17 | 55.1 | 58.1 | 61.2 | 64.2 | 67.3 | 68.8 | 70.4 | 71.9 | 73.4 | 74.9 | 76.5 | 78.0 | 79.5 | 81.1 | 82.9 |
| 18 | 52.0 | 54.9 | 57.8 | 60.7 | 63.6 | 65.0 | 66.4 | 67.9 | 69.3 | 70.8 | 72.2 | 73.7 | 75.1 | 76.6 | 78.0 |
| 19 | 49.3 | 52.0 | 54.7 | 57.5 | 60.2 | 61.6 | 62.9 | 64.3 | 65.7 | 67.1 | 68.4 | 69.8 | 71.2 | 72.5 | 73.9 |
| 20 | 46.8 | 49.4 | 52.0 | 54.6 | 57.2 | 58.5 | 59.8 | 61.1 | 62.4 | 63.7 | 65.0 | 66.3 | 67.6 | 68.9 | 70.2 |
| 21 | 44.6 | 47.0 | 49.5 | 52.0 | 54.5 | 55.7 | 57.0 | 58.2 | 59.4 | 60.7 | 61.9 | 63.1 | 64.4 | 65.6 | 66.9 |
| 22 | 42.5 | 44.9 | 47.3 | 49.6 | 52.0 | 53.2 | 54.4 | 55.5 | 56.7 | 57.9 | 59.1 | 60.3 | 61.5 | 62.6 | 63.8 |
| 23 | 40.7 | 43.0 | 45.2 | 47.5 | 49.7 | 50.9 | 52.0 | 53.1 | 54.3 | 55.4 | 56.5 | 57.6 | 58.8 | 59.9 | 61.0 |
| 24 | 39.0 | 41.2 | 43.3 | 45.5 | 47.7 | 48.8 | 49.8 | 50.9 | 52.0 | 53.1 | 54.2 | 55.3 | 56.3 | 57.4 | 58.5 |
| 25 | 37.4 | 39.5 | 41.6 | 43.7 | 45.8 | 46.8 | 47.8 | 48.9 | 49.9 | 51.0 | 52.0 | 53.0 | 54.1 | 55.1 | 56.2 |
| 26 | 36.0 | 38.0 | 40.0 | 42.0 | 44.0 | 45.0 | 46.0 | 47.0 | 48.0 | 49.0 | 50.0 | 51.0 | 52.0 | 53.0 | 54.0 |
| 27 | 34.7 | 36.6 | 38.5 | 40.4 | 42.4 | 43.3 | 44.3 | 45.3 | 46.2 | 47.2 | 48.1 | 49.1 | 50.1 | 51.0 | 52.0 |
| 28 | 33.4 | 35.3 | 37.1 | 39.0 | 40.9 | 41.8 | 42.7 | 43.6 | 44.5 | 45.5 | 46.4 | 47.4 | 48.3 | 49.2 | 50.1 |
| 29 | 32.3 | 34.1 | 35.9 | 37.7 | 39.4 | 40.3 | 41.2 | 42.1 | 43.0 | 43.9 | 44.8 | 45.7 | 46.6 | 47.5 | 48.4 |
| 30 | 31.2 | 32.9 | 34.7 | 36.4 | 38.1 | 39.0 | 39.9 | 40.7 | 41.6 | 42.5 | 43.3 | 44.2 | 45.1 | 45.9 | 46.8 |
| 31 | 30.2 | 31.9 | 33.5 | 35.2 | 36.9 | 37.7 | 38.6 | 39.4 | 40.3 | 41.1 | 41.9 | 42.8 | 43.6 | 44.5 | 45.3 |
| 32 | 29.3 | 30.8 | 32.5 | 34.1 | 35.8 | 36.6 | 37.4 | 38.2 | 39.0 | 39.8 | 40.6 | 41.4 | 42.3 | 43.1 | 43.9 |
| 33 | 28.4 | 29.9 | 31.5 | 33.1 | 34.7 | 35.5 | 36.2 | 37.0 | 37.8 | 38.6 | 39.4 | 40.2 | 41.0 | 41.9 | 42.5 |
| 34 | 27.5 | 29.1 | 30.6 | 32.1 | 33.6 | 34.4 | 35.2 | 35.9 | 36.7 | 37.5 | 38.2 | 39.0 | 39.8 | 40.5 | 41.3 |

GEAR CHART FOR 27" WHEEL

| TEETH REAR SPROCKET | Number of teeth, Chainwheel (large front sprocket) | | | | | | | | | | | | | | |
|---------------------------|--|------|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| | 36 | 38 | 40 | 42 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 |
| 14 | 69.4 | 73.3 | 77.1 | 81.0 | 84.9 | 86.8 | 88.7 | 90.6 | 92.6 | 94.5 | 96.4 | 98.4 | 100.3 | 102.2 | 104.1 |
| 15 | 64.8 | 68.4 | 72.0 | 75.6 | 79.2 | 81.0 | 82.8 | 84.6 | 86.4 | 88.2 | 90.0 | 91.8 | 93.6 | 95.4 | 97.2 |
| 16 | 60.8 | 64.1 | 67.5 | 70.9 | 74.3 | 76.0 | 77.6 | 79.3 | 81.0 | 82.7 | 84.4 | 86.1 | 87.8 | 89.4 | 91.1 |
| 17 | 57.2 | 60.4 | 63.5 | 66.7 | 69.9 | 71.5 | 73.1 | 74.6 | 76.2 | 77.8 | 79.4 | 81.0 | 82.6 | 84.2 | 85.8 |
| 18 | 54.0 | 57.0 | 60.0 | 63.0 | 66.0 | 67.5 | 69.0 | 70.5 | 72.0 | 73.5 | 75.0 | 76.5 | 78.0 | 79.5 | 81.0 |
| 19 | 51.2 | 54.0 | 56.8 | 59.7 | 62.5 | 64.0 | 65.4 | 66.8 | 68.2 | 69.6 | 71.1 | 72.5 | 73.9 | 75.3 | 76.7 |
| 20 | 48.6 | 51.3 | 54.0 | 56.7 | 59.4 | 60.8 | 62.1 | 63.5 | 64.8 | 66.2 | 67.5 | 68.9 | 70.2 | 71.6 | 72.9 |
| 21 | 46.4 | 48.9 | 51.4 | 54.0 | 56.6 | 57.9 | 59.1 | 60.4 | 61.7 | 63.0 | 64.3 | 65.6 | 66.9 | 68.1 | 69.4 |
| 22 | 44.2 | 46.6 | 49.1 | 51.5 | 54.0 | 55.2 | 56.5 | 57.7 | 58.9 | 60.1 | 61.4 | 62.6 | 63.8 | 65.0 | 66.3 |
| 23 | 42.3 | 44.6 | 47.0 | 49.3 | 51.6 | 52.8 | 54.0 | 55.2 | 56.3 | 57.5 | 58.7 | 59.9 | 61.0 | 62.2 | 63.4 |
| 24 | 40.5 | 42.8 | 45.0 | 47.3 | 49.5 | 50.6 | 51.8 | 52.9 | 54.0 | 55.1 | 56.3 | 57.4 | 58.5 | 59.6 | 60.8 |
| 25 | 38.9 | 41.0 | 43.2 | 45.4 | 47.5 | 48.6 | 49.7 | 50.8 | 51.8 | 52.9 | 54.0 | 55.1 | 56.2 | 57.2 | 58.3 |
| 26 | 37.4 | 39.5 | 41.5 | 43.6 | 45.7 | 46.7 | 47.8 | 48.8 | 49.8 | 50.9 | 51.9 | 53.0 | 54.0 | 55.0 | 56.1 |
| 27 | 36.0 | 38.0 | 40.0 | 42.0 | 44.0 | 45.0 | 46.0 | 47.0 | 48.0 | 49.0 | 50.0 | 51.0 | 52.0 | 53.0 | 54.0 |
| 28 | 34.7 | 36.6 | 38.5 | 40.5 | 42.4 | 43.4 | 44.4 | 45.3 | 46.3 | 47.2 | 48.2 | 49.2 | 50.1 | 51.1 | 52.1 |
| 29 | 33.5 | 35.4 | 37.2 | 39.1 | 41.0 | 41.9 | 42.8 | 43.8 | 44.7 | 45.6 | 46.6 | 47.5 | 48.4 | 49.3 | 50.3 |
| 30 | 32.4 | 34.2 | 36.0 | 37.8 | 39.6 | 40.5 | 41.4 | 42.3 | 43.2 | 44.1 | 45.0 | 45.9 | 46.8 | 47.7 | 48.6 |
| 31 | 31.4 | 33.1 | 34.8 | 36.6 | 38.3 | 39.2 | 40.1 | 41.0 | 41.8 | 42.6 | 43.5 | 44.4 | 45.2 | 46.2 | 47.0 |
| 32 | 30.4 | 32.1 | 33.8 | 35.4 | 37.1 | 38.0 | 38.8 | 39.7 | 40.5 | 41.3 | 42.2 | 43.0 | 43.9 | 44.7 | 45.6 |
| 33 | 29.5 | 31.1 | 32.7 | 34.4 | 36.0 | 36.8 | 37.6 | 38.5 | 39.3 | 40.1 | 40.9 | 41.7 | 42.5 | 43.4 | 44.2 |
| 34 | 28.6 | 30.2 | 31.8 | 33.3 | 34.9 | 35.7 | 36.5 | 37.3 | 38.1 | 38.9 | 39.7 | 40.5 | 41.3 | 42.1 | 42.9 |

L - SPEED (In miles per hour) :

This might be the most important variable. When changes are made to the other variables, the rider should look at what happens to Speed. If Speed is already known from an actual ride, it is entered here and Power (S) will be calculated, thereby calibrating the ride. A change in Speed will affect Cadance (K), Time (M), Wind load (P), Total load (Q), Work (R), and Power (S).

M - TIME (In minutes) :

Just like Speed (L), if time is already known, it can be entered here. A change in Time will affect Cadance (K), Speed (L), Wind load (P), Total load (Q), Work (R), and Power (S).

N - WEIGHT LOAD (In pounds) :

Weight load cannot be input. It is the result of total weight (D+E) and Gradient (B). A positive value means uphill and work is required. A negative value means downhill, and energy is available to help overcome Rolling load (O) and Wind load (P).

O - ROLLING LOAD (In pounds) :

Rolling load cannot be input. It is the result of total weight (D+E) and Rolling friction (F). Rolling load is always positive and acts to slow the bicycle down.

P - WIND LOAD (In pounds) :

Wind load cannot be input. It is the result of bike Speed (L), Wind speed (H), Wind direction (I), and Wind factor (G). Wind load increases greatly at higher speeds.

Q - TOTAL LOAD (In pounds) :

Total load cannot be input. It is the sum of Weight load (N), Rolling load (O), and Wind load (P). A higher Total load means a lower Speed (L).

R - WORK (In pound-miles) :

Work cannot be input. It is calculated as Total load (Q) multiplied by Distance (A). For uphill, Work is a measure of how tough the hill is, and can be compared with Work levels for other hills. The following page contains a list of hill climbs and their related Work levels.