

Overview of Celestial Navigation, an Excel Workbook

The **Celestial Navigation** workbook was developed over the past 13 years as a Teaching Aid for United States Power Squadrons® Advanced Grade classes. This Excel Workbook can also be used for checking JN and N sight folders, homework problems & exams. It can also be used as a tutorial by anyone interested in learning the basic principles of celestial navigation. This Workbook won "Best of Show" as a Teaching Aid at the United States Power Squadrons® District 16 Fall Conference in 2009. This workbook can be downloaded from the USPS District 16 web site <https://www.uspsd16.org> From the "Dept. Info" dropdown menu select "Educational" and under "Quizzes | Workbooks | Software" select "Celestial Navigation".

All cells of the workbook are protected except for the yellow user data entry cells. This prevents the inadvertent modification of cells containing formulas used to calculate the results. Most of the Worksheets have an associated Macro for clearing the user input cells of previously entered data. These Worksheet Macros are provided to prevent data from a previous problem being overlooked when entering data for a new problem. Units associated with cells use abbreviations & acronyms from *The American Practical Navigator "Bowditch" Pub No.9 2002 Bicentennial Edition*.

The **Celestial Navigation** workbook contains the following 30 worksheets:

- **Nav Bodies** .. The **Nav Bodies** worksheet is the core of this workbook. The **Nav Bodies** worksheet calculates data contained in the *Nautical Almanac* for Sun, Moon, Planets & Stars for a given date, time & position using formulas from Jean Meeus "*Astronomical Algorithms*" second edition and the **VSOP87** data for the earth & planets and **ELP-2000/82** data for the moon. Data from the **Nav Bodies** worksheet is used in most of the worksheets listed below.
- **Sight Planning** .. Help in selecting bodies for a two or three body fix
- **Sight Averaging** .. Shows a graph of up to 10 sights and allows bad sights to be removed
- **Meridian Transit** .. Calculates time of Meridian transit from a series of sights taken before & after **MT**
- **Sight Reduction** .. Sight Checker for the back of **USPS Form SR96** .. Law of Cosines Method +NASR +HO229 Also provides a Time Diagram and a Meridian Diagram
- **SR 96** .. Sight Checker for front of **USPS Form SR96**
- **SR by DC** .. Sight Reduction by Direct Computation, *Nautical Almanac* pages 277--> 285
- **Sumner LOP** .. From an observation of the Sun this worksheet calculates the Longitudes associated with 3 user specified Latitudes which define a Line of Position (**LOP**) from which the observed altitude of the Sun would have the same value if taken at the same instant of time from any point along the LOP using the method developed by Capt. Thomas H. Sumner
- **Fix Sans DR** .. Calculates a Fix using the Intersections of Circles of Equal Altitude from Two or Three Bodies
- **Fix by DC** ... Position from intercept & azimuth by direct calculation, *Nautical Almanac* pages 282 & 283
- **DR 2 Body Fix** .. Two Body Fix, from a DR position
- **AP 2 Body Fix** .. Two Body Fix, from assumed positions
- **DR 3 Body Fix** .. Three Body Fix, from a DR position

- **AP 3 Body Fix** .. Three Body Fix, from assumed positions
- **NA I & C** .. Increments & Corrections formatted as shown in the *Nautical Almanac*
- **Hs to Ho** .. Calculates Observed Altitude from Sextant altitude, *Nautical Almanac* pages 280 & 281
- **Moon hs to Ho** .. Moon Altitude Corrections, *Nautical Almanac* pages xxxiv & xxxv
- **Polaris** .. Latitude by Sight on Polaris, *Nautical Almanac* pages 274 & 275
- **24 Hc & Zn** .. A graph of the Sun's Altitude and Azimuth vs Zone Time for a given date & position
- **Analemma** .. A graph of the Sun's Declination vs the Equation-of-Time for an entire year
- **Set & Drift** .. Calculates set & drift +Track & SMG + Course to Steer & SOA
- **Course & Distance** .. Calculated using rhumb line or Mid-Latitude equations
- **Arrival Coordinates** .. Calculated using rhumb line or Mid-Latitude equations
- **Great Circle Route** .. Calculates Great Circle Distance and initial course heading
- **60 D ST** .. Speed, Time & Distance calculations
- **Interpolation** .. and Data Conversions
- **NAV Coordinates** .. Celestial Navigation Coordinates & the Celestial Sphere
- **Yellow Pages** .. Nautical Almanac Increments & Corrections accurate to 0.01'
- **Rhumb Line** .. Rhumb Distance vs. Great Circle Distance
- **Tides** .. Rule of 1/12 for Tide Prediction