Overview of Celestial Navigation, an Excel Workbook

The **Celestial Navigation** workbook was developed over the past 14 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 use 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 34 worksheets:

- **Nav Bodies ..** The **Nav Bodies** worksheet is the core of this workbook. The **Nav Bodies** worksheet calculates data equivalent to what is 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 ..** Provides help in selecting bodies for a two or three body fix; Also provides the geocentric lunar distance to visible bodies.

- **Sight Averaging ..** Calculates the average sextant altitude & the associated time for a string of up to 10 sights and allows bad sights to be removed.

- **Meridian Transit ..** From a series of sights taken a short time before & after meridian transit, this worksheet calculates the zone time of meridian transit & the associated sextant altitude at meridian transit. Given the GHA & declination of the body at the calculated zone time of meridian transit, this worksheet also calculates the observer's latitude & longitude.

- **Sight Reduction ..** Sight Checker for the back of **USPS Form SR96** .. Law of Cosines Method +NASR +HO229 Also provides a time diagram and the diagram on the plane of the observer's meridian.

- **SR 96 ..** Sight reduction using the Law of Cosines, this worksheet provides the data needed for checking the front of the **USPS Form SR96.**

- **NASR Table ..** Sight Reduction using the **Nautical Almanac** concise sight reduction tables.

- **HO 229 ..** Sight Reduction using the H. O. Pub. 229 Sight Reduction Tables for Marine Navigation.

- **SR by DC ..** Sight Reduction by Direct Computation, **Nautical Almanac** pages 277--> 285

- **LOP Data ..** Saves the data from **Sight Reduction, SR 96, NASR Table** & **SR by DC** worksheets needed for plotting Celestial LOPs on the CLS 98 Form.

- **Sumner LOP ..** From an observation of the Sun this worksheet calculates the Longitudes associated with three 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 ..** Calculates the Latitude & Longitude of a Two Body Fix, from a DR position

- **AP 2 Body Fix ..** Calculates the Latitude & Longitude of a Two Body Fix, from assumed positions.

- **DR 3 Body Fix ..** Calculates the Latitude & Longitude of a Three Body Fix, from a DR position.

- **AP 3 Body Fix ..** Calculates the Latitude & Longitude of a Three Body Fix, from assumed positions.

- **NA I & C ..** Increments & Corrections formatted as shown in the *Nautical Almanac.*

- **Dip ..** Calculates tables of dip corrections for a natural sea horizon in minutes of arc for height of eye in feet or meters + tables for dip corrections short of a natural sea horizon in minutes of arc for height of eye in feet or meters & dip short distance in yards, meters or nautical miles.

- **Hs to Ho ..** Calculates Observed Altitude for the Sun, Moon, planets & stars from Sextant altitude, using equations from pages 280 & 281 of the *Nautical Almanac*

- **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 & speed made good + course to steer & speed of advance.

- **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 ..** Interpolation & Data Conversions.

- **NAV Coordinates ..** Diagram of the celestial sphere & definition of the celestial navigation coordinates.

- **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.