LANE COVE
CREATIVE
PHOTOGRAPHY

Essential Skills Program 2023

EXPLORING YOUR CAMERA AND CONTROLS

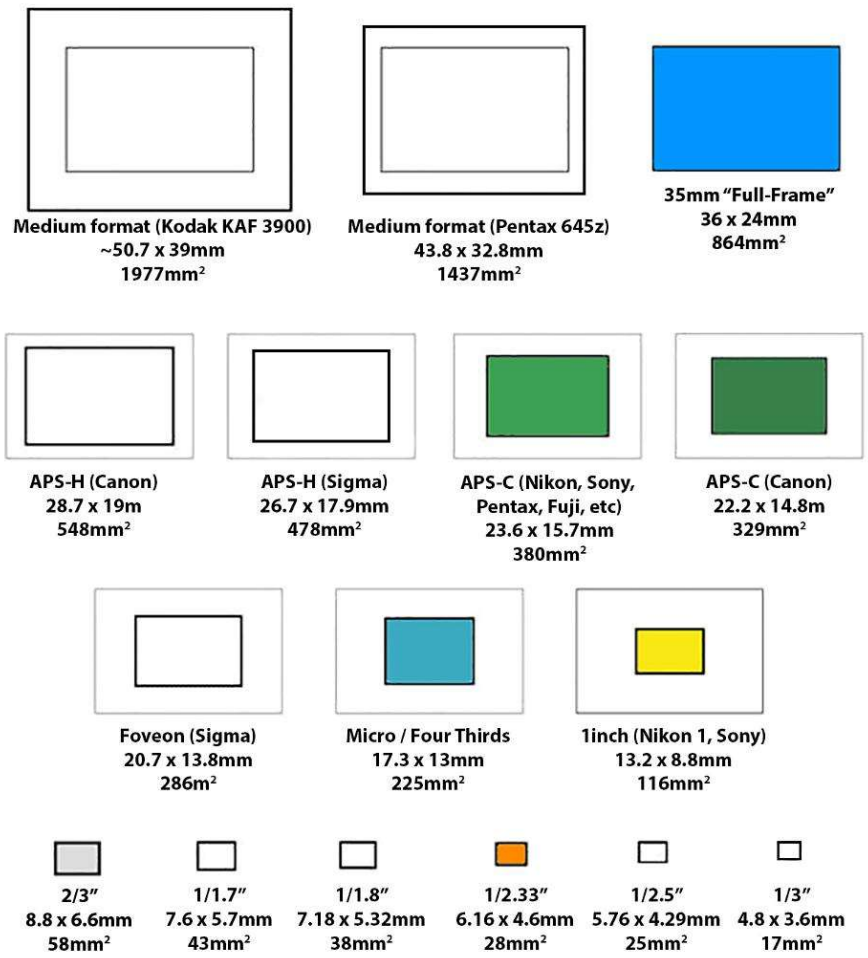
These notes accompany the presentation at Lane Cove Creative Photography on 16th February 2023, presented by Jim Crew and Michael Smyth.

Camera types and uses.

There are many different types of camera, although in principle, they all follow the same basic design: A lightproof box with a lens, aperture and shutter to control how much light reaches the sensor.

Smartphones start from a few hundred dollars and at the upper end of the camera scale we have medium format cameras that start from around $50k plus. Each has their use and purpose, although the most common variety is the DSLR or Mirrorless ILC (**I**nterchangeable **L**ens **C**amera). Mirrorless and DSLR cameras come in either crop sensor size (micro four thirds, APS-C etc) or "Full Frame" sensors. The term "Full Frame" refers to the size of 35mm film (24mm x 36mm) often considered as the "standard" sensor size.

Above: *A camera obscura and a modern digital camera. In basic principles they are very similar*



Left: *Sensor sizes compared. Full frame sensor size shown in blue, crop sensors shown in green and micro four thirds shown in a teal colour.*

The size of the sensor used in a camera to some extent determines the quality of the image, although equally important is the quality of the lenses and the resolution (total number of pixels) of the sensor. Crop sensor cameras are popular as they are mostly smaller and lighter than the full frame equivalent, with very little trade off in image quality.

How good are smartphone images?

Non photographers often claim that their smartphone can produce images as good as a DSLR camera, claiming that their images can be printed to "poster size" (whatever that means). Of course, this is nonsense. Smartphones can capture good images in ideal conditions that look great on the phone's screen, but the quality quickly deteriorates as conditions get less ideal and the enlargement gets bigger. There is a reason that quality cameras with expensive lenses do a much better job and it's called "***Physics***." A tiny sensor with a small piece of glass can't hope to compare to a dedicated camera with a large sensor and quality lens.

But, if a smartphone is the only camera you have with you, it can be "good enough".

Left: *Can a smartphone compare to a dedicated digital camera and lens?*

In ideal conditions, maybe, but in all other cases, No!

For further reading go to www.dpeview.com:
https://www.dpreview.com/news/6125283026/video-google-pixel-7-pro-vs-canon-r5-difference-between-smartphones-real-cameras

Why your camera lies to you.

When using our cameras we rely on the information relayed to us via the screen and viewfinder (on mirrorless cameras). But unfortunately, the information our camera shows us in not the full picture (pun intended). There are several reasons for this:

- When using a DSLR we look through the lens, but what is captured is a little different as the image is recorded as a RAW file (which is not viewable) by the sensor. We need to study the captured image on the rear screen to see what was captured, but this isn't correct either (see below).
- When we look on the screen at the back of the camera, or through the viewfinder on a mirrorless camera, we are not seeing the image (again as the RAW file is not viewable). What we are seeing is a JPEG render of the data being received by the sensor. JPEGs by their nature are compressed 8 bit images that have had the highlights and shadows clipped. Plus, we are looking at a screen that is around 2 Megapixels, so we can't see the whole image anyway. The best we can do is zoom in to 100% to check focus and movement, but colour and tonal range are approximate only.

- The histogram displayed during playback, or in live view is also based on the JPEG render, so tends to show blown out highlights incorrectly.

So, the information that you can access at the time of capture is not entirely reliable, meaning that we need to use our experience and assessment of the situation to decide if we have captured what we wanted. The only way to be sure of what we captured is to open the RAW file in image editing software (with the default render of the image) and make some informed adjustments to the data.

Experience with photographing in a variety of different situations, plus viewing what the camera tells us will allow you to make an informed assessment of what you captured and decide if you need to make further exposures and/or compositions.

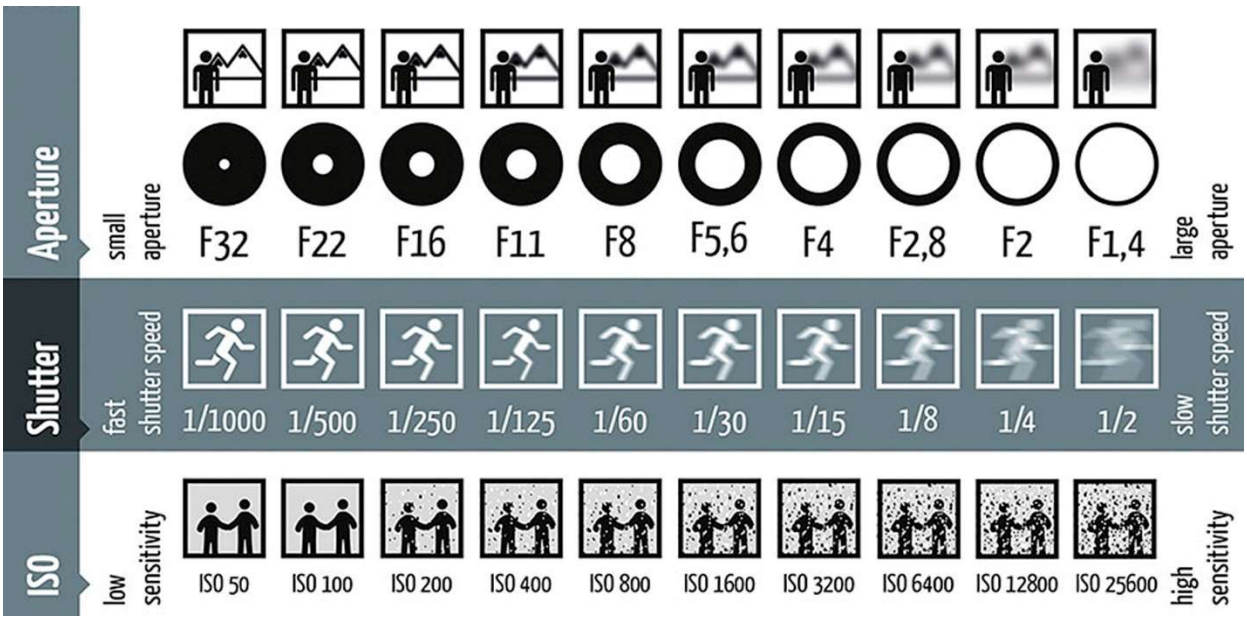
Left: *What the camera shows us is not the image. In this case, seeing is NOT believing.*

The "Holy Trinity" of camera controls

There are three controls that determine what information is captured in our images:

- ***Aperture*** – the size of the hole in the lens that light passes through.
- The ***Shutter speed*** – the time that the light has to register the image data on the sensor.
- The ***ISO sensitivity*** of the sensor – that determines how much light is needed to make a "correct" exposure and the quality, or signal to noise ratio.

Used together these three controls provide a range of adjustments for different aspects of the image. Each of these controls is adjusted in "Stops" or steps, with each full step change in any of the settings either doubling or halving the amount of exposure. With film, it was only necessary to change in full steps, but with more sophisticated digital sensors, we now make these changes in 1/3 steps, for greater control.



Above: *Aperture, Shutter speed and ISO steps. Each step shown above either halves or doubles the amount of light captured.*

Understanding this fundamental relationship is the most important aspect of understanding how images are captured.

Let's now look at each of these controls in detail.

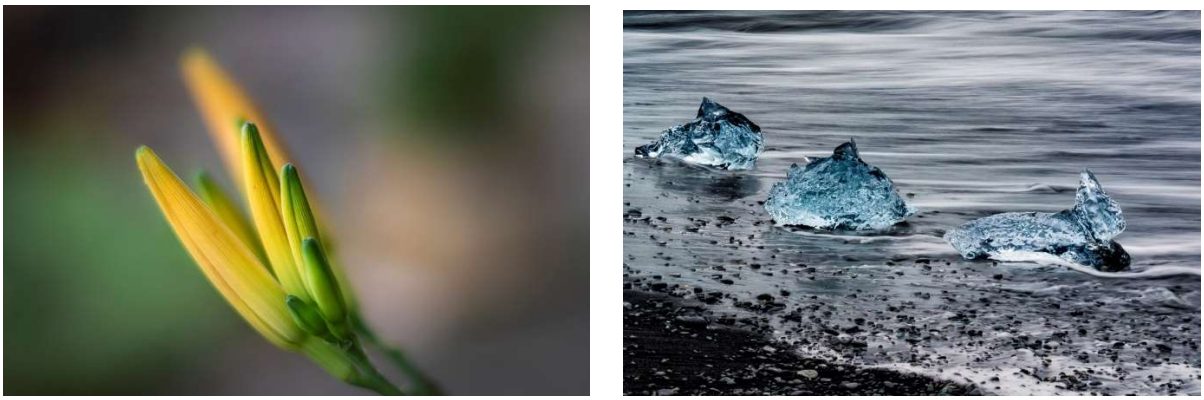
Aperture

The aperture settings often lead to confusion amongst photographers at all skill levels. The terminology is confusing as a very large aperture, such as f1.4 sounds like it should be smaller than a small aperture of say, f22. An easy way to visualise these numbers is to think of them as fractions: 1/1.4 is a bigger fraction than 1/22. Each step in aperture halves or doubles the area of the hole that light passes through.

Above: *Different apertures in detail.*

The essential aspect of image capture controlled by the aperture setting is determining how much of the image appears sharply focussed (there is technically only one plane of focus, with a range in front and behind that looks acceptably "sharp"). ***The amount of acceptable sharpness in front and behind the focus plane is determined by the aperture setting.***

A small aperture maximises the amount of the image that looks sharp, and the range of the sharpness varies with the focal length of the lens. Wide angle lenses have a greater range of acceptable sharpness – called ***"Depth of Field"*** for any given aperture, whereas a long focal length lens has much less depth of field for the same aperture. Using a lens at its smallest aperture can lead to softness in the image due to a phenomenon called "diffraction", so it is best to avoid using the minimum aperture as much as possible.

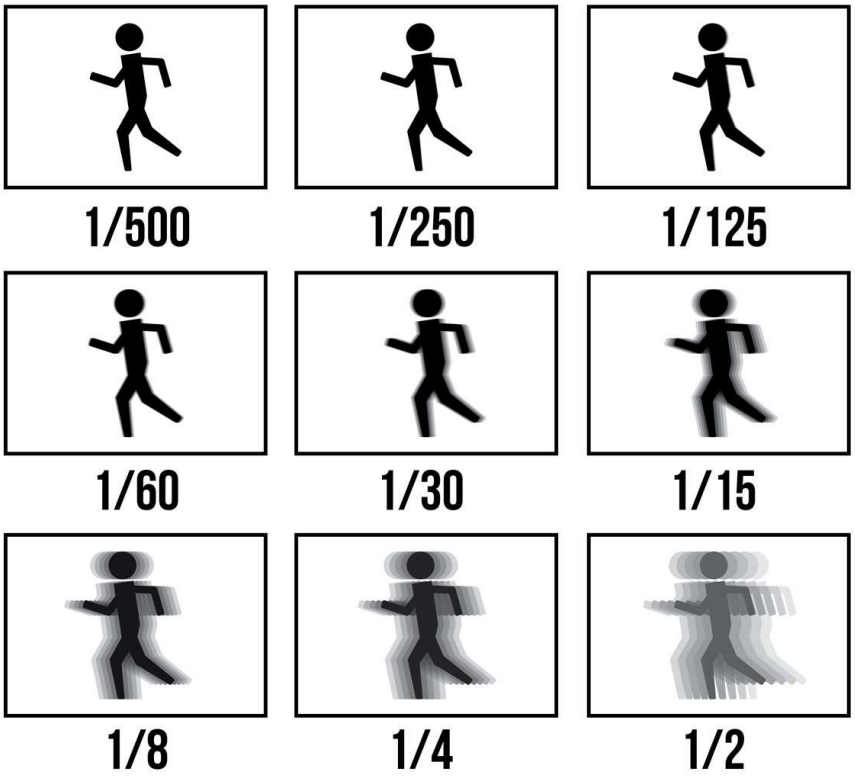


Above: *Left – a shallow depth of field (f1.4), Right – a large depth of field (f22).*

Shutter speed

The shutter speed selected determines the time that light has to travel through the lens and onto the sensor. Shutter speeds are measured in fractions of a second, all the way up to multiples of seconds for long exposures in low lighting.

The shutter speed determines how much movement is captured in the image. This movement can be the subject matter, the camera, or both.



Above: *Shutter speeds in practice. Most modern cameras can go as far as 1/4000 of a second to really freeze fast motion, with the longest camera controlled shutter speed of 30 seconds or more.*

Above: *Left - a fast shutter speed is needed to freeze motion (1/800 sec). Right - long exposures (on a tripod) can show movement in water (4.0 secs).*

ISO Sensitivity

ISO sensitivity often just called "***ISO***" (Acronym for **I**nternational **S**tandards **O**rganisation) determines how much light is required for a "correct" exposure. Correct exposure will vary from subject to subject, but for our use we will call it the amount of exposure needed to capture a full tonal range without clipping (over exposing) the highlights.

All camera sensors are designed with a "base" or ideal ISO sensitivity, where the sensor has the greatest dynamic range (range of tones it can record – up to 11 or more stops) and maintain the lowest noise levels. Usually, this base ISO sensitivity is either 64 or 100 ISO. Increasing the ISO sensitivity decreases the amount of light needed to record the "correct" exposure. The downside of increasing the ISO sensitivity is an increase in noise (unwanted grain of multi coloured spots) and a decrease in dynamic range.

Photographers need to conduct tests to see what is the highest ISO setting they can accept and deal with in processing. This varies from camera to camera and the software in use.

Above: *Base ISO gives the best results. Right High ISO (8000) for difficult lighting.*

Controlling Exposure

There are four common ways to control exposure, but when coupled with using manual or auto ISO, there are multiple permutations. For convenience we will refer to the four main variations. The light entering your camera is measured by a light meter inside the camera, with the actual exposure being determined by a combination of the Aperture, Shutter speed and ISO setting.

The basics of controlling exposure

There are four common ways to control exposure, which can then be coupled with using manual or auto ISO, to give further options. For convenience we will refer to the four main variations.

Using the "***Holy Trinity***" of exposure controls, here are the possible options:

NAME	SHUTTER	APERTURE	ISO	USES
FULL MANUAL	Manual	Manual	Manual or auto	Learning how to use controls, some extreme lighting situations.
SHUTTER PRIORITY	Manual	Auto	Manual or auto	Where shutter speed is critically important, such as sports action.
APERTURE PRIORITY	Auto	Manual	Manual or auto	Where depth of field is more important, tripod use, Auto ISO where a minimum shutter speed is required.
PROGRAM	Auto	Auto	Manual or auto	Standard program mode usually uses auto flash as well. Not suited to most applications.

Wherever a tripod is going to be used, generally lower ISO values can be used, with either Aperture or Shutter Priority modes and manual ISO.

For general use, ***Shutter Priority*** or ***Aperture Priority*** are the "go to" modes, leaving creative control in the hands of the user.

Capture methods for different situations

Aperture priority

The photographer sets the required aperture, and the camera determines the shutter speed, with either manual ISO or Auto ISO used to control the overall exposure options.

Aperture priority is best suited to situations where the depth of field is the most important consideration, such as landscapes, architecture and portraiture.


Above: *Examples of Aperture priority scenarios – depth of field most important.*

Shutter priority

The photographer sets the shutter speed required and the camera determines the aperture, with either manual or Auto ISO to control the overall exposure.

Shutter priority is best suited to situations where the control of movement in the image is paramount, such as sports action, hand held nature, tripod mounted landscapes with movement (water).


Above: *Shutter priority scenarios. Left - 1/800 sec to freeze motion. Right – 1/15 sec and panning to follow motion.*

Sports action and wildlife shooters generally use Shutter priority with auto ISO, to allow them the freedom to concentrate on the action in front of them.

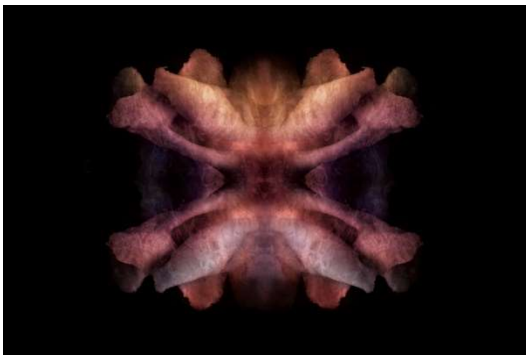
For long exposures, generally on a tripod, the shutter speed allows the recording of motion or smoothing moving water.


Above: *Lightning recorded at 20 seconds. Right 25 seconds smooths out moving water.*

Full Manual

The photographer sets all controls manually: Aperture, shutter, and ISO. This is useful when learning the basics of the relationships between settings and in some difficult lighting situations, but is slow and cumbersome.

Full manual control is useful in macro photography where there is a requirement for controlled aperture as well as shutter speed.




Above: *Full manual control for macro and difficult lighting situations.*

Program Mode

In program mode, the camera makes all the decisions, although it will often opt to use the built in flash at inappropriate times, plus it does not take account of different situations.

The camera can't know what the scenario is for the photograph and makes a "best guess" based on parameters determined by the camera manufacturer. This is not recommended for any serious photography and the user has no input and will learn nothing about the important controls.

Other Scenarios

There are many photographic situations that may require a combination of capture methods to best record a scene and the choices will vary depending on the photographer's preferences.

These other situations include:

- Macro photography
- Street photography
- Travel photography
- Family situations (records)

Controlling what the camera "thinks" – advanced options.

Our cameras don't always get things right, unusual lighting or situations can throw out the exposure meter so we sometimes need to take control of one or more settings. Things we might want to take charge of are as follows.

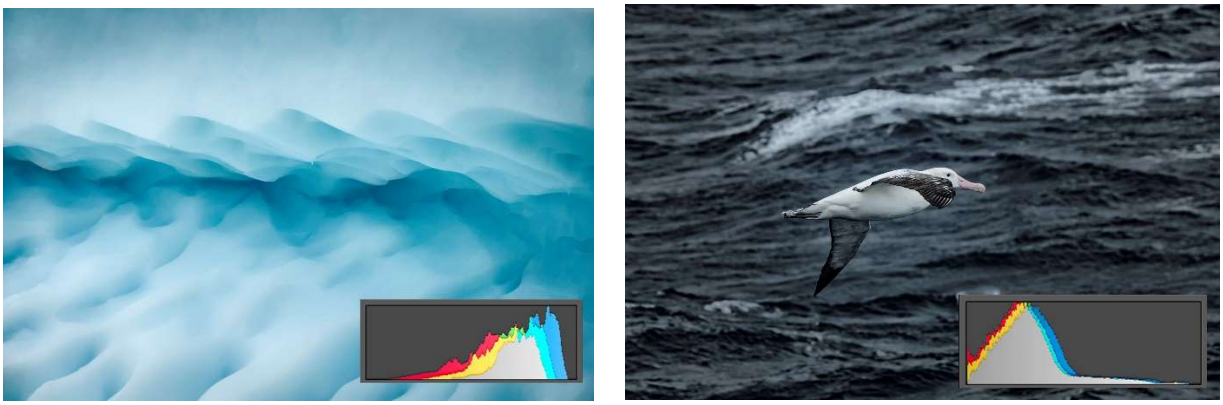
Exposure compensation

Unusual lighting conditions can cause the metering systems to provide the wrong exposure. Excessively bright scenes such as snow and ice can lead to an underexposure, whereas excessively dark scenes and lead to overexposure. This happens because the metering system assumes that each scene has a mix of tones from light to dark and it tries to balance to the middle tone – mid grey.


Above: *unusual lighting can confuse the metering system.*

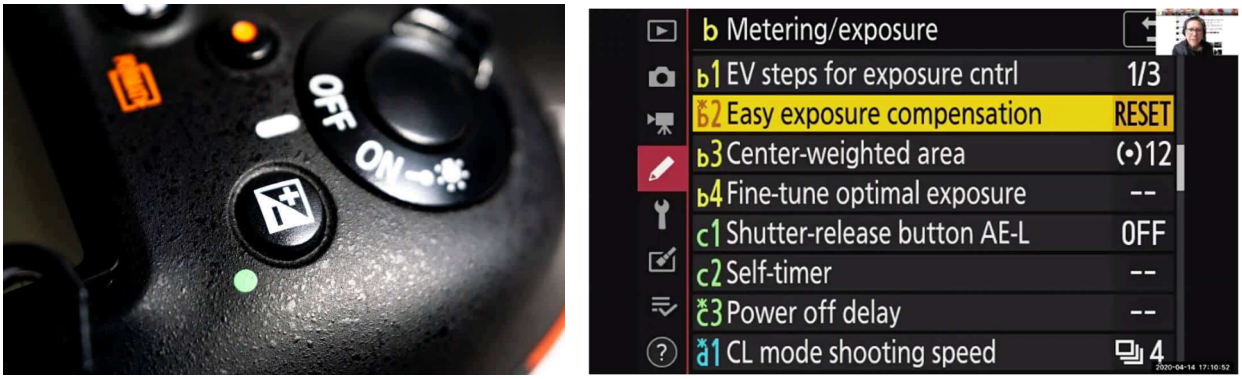
Using the camera's histogram, either in live view or after a test shot is taken can offer a guide to what compensation is needed. A bright scene with lots of highlights should show the histogram with a large bulge at the right hand end, but not clipped. If the

histogram shows space at the right hand end, you need to add more exposure – positive (+) compensation.



Above: *Add exposure compensation to bright subjects. Right, reduce exposure for dark subjects.*

All cameras have a way of applying exposure compensation. A button or menu item with a +/- symbol will allow you to adjust the meter setting.



Above: *Exposure compensation button. Right: Nikon cameras allow quick exposure compensation using the rear dial that resets when the meter turns off. Adding compensation for one image and then forgetting to reset is often a cause for frustration amongst photographers.*

Changing the metering method

Another way to overcome issues with the way the camera is reading a scene is to use one of the alternative metering methods.

There are generally at least three different ways the camera can measure the exposure.

The different ways our cameras can evaluate the exposure are:

- ***Matrix*** (Nikon) or ***Evaluative*** (Canon), where the camera applies different weighting to different areas within the frame. By default, all cameras will be set to this method or its equivalent.
- ***Centre weighted***, where the camera only uses a centre portion of the viewfinder to calculate the exposure settings.
- ***Spot metering***, where the camera only measures the exposure from a very small area in the centre of the frame.

Each of these methods is useful in differing situations. Matrix or Evaluative is the best all round method where there is generally a good mix of tones. Centre weighted metering is ideal for backlit subjects or where the background is much brighter or darker than the main subject matter. Spot metering is ideal for situations where the main element is relatively small in the frame.

Above: *Left – a well balanced scene where matrix metering is ideal. Right – a dark background requires centre weighted metering to avoid over exposure.*

Left: *A small subject area may require the use of spot metering on the face to manage the exposure.*

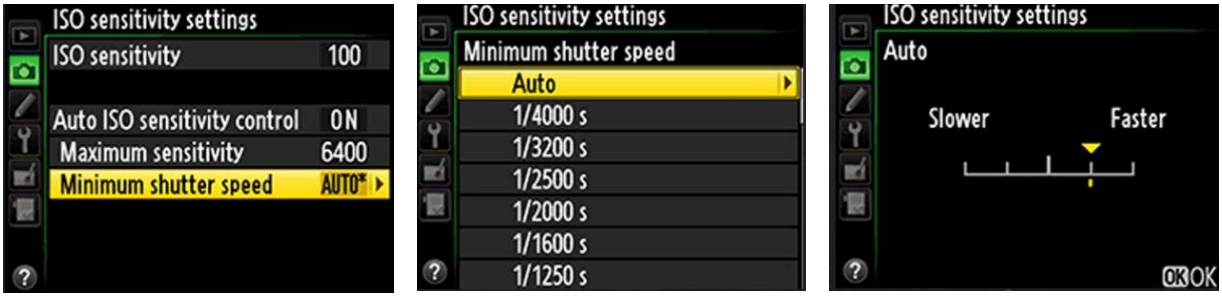
More recent mirrorless cameras also use the selected focus area to weight the exposure calculation in addition to the matrix or evaluative metering, but even so, in some cases the conditions will fall outside the camera's capability to set the correct exposure.

Setting limits on auto ISO and minimum shutter speeds

A key feature of digital photography is the ability to shoot images with differing ISO settings to suit the conditions. Film users were limited to a set ISO for the given film in use and even then, the maximum ISO available was around 400 ISO.

With auto ISO, using either aperture priority or shutter priority, the camera works within defined limits to try to capture a sharp image without movement or shake. If using aperture priority, the camera will try to maintain a usable shutter speed (depending on the focal length of the lens) and increase the ISO to compensate where the lighting level is insufficient. For shutter priority with auto ISO, the camera will adjust the aperture to maintain the selected shutter speed and then increases the ISO accordingly when it has reached the widest aperture available.

Most cameras allow the user to set the maximum ISO to be used and also to select either a fixed minimum shutter speed, or to automatically change the minimum shutter speed depending on the lens in use. Depending on the make and model of camera being used, these settings will appear under different menu items.



Above: *Auto ISO settings for most Nikon cameras. You set the maximum allowable ISO and then the minimum shutter speed – in this case "auto" where the minimum depends on the focal length lens in use. Finally, you choose how slow the minimum should be on a sliding scale (relative to 1/focal length).*

For each individual user and camera combination, the photographer should do some tests to see what is the highest ISO setting they can handle (given the type of noise reduction software they use) and the minimum shutter speed they feel confident in using. With these determined, the user can then set these parameters with confidence.

Above: *What is your maximum usable ISO? Left - 12,800, Right - 6400.*

Setting the minimum shutter speed allows the photographer to concentrate on capturing the image in the knowledge that their technique will give them an acceptably sharp image. Newer cameras with ***"IBIS"*** (**I**n **B**ody **I**mage **S**tabilisation) and lenses with active vibration reduction can allow slower handheld photos than previously, the rule being 1/focal length of the lens. This meant that for a 200mm lens, the minimum shutter speed should be 1/200 sec. The only way to be confident in your settings is to do tests to see how your technique handles different situations.

Needless to say, when using the camera on a tripod, there is no need for using auto ISO, unless you want to freeze all motion.

Above: *Hand held, ISO 6400, wide angle lens, 1/13 sec.*

Topics for a future session

In future sessions we will look at more advanced techniques, including:

- Exposure bracketing
- Focus stacking (automated and manual)
- Focus modes, single and continuous, manual.
- Custom settings
- Release mode (focus or shutter)
- Supplementary lighting